OCTOBER 19, 1959

Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

R RESEARCH
D DEVELOPMENT

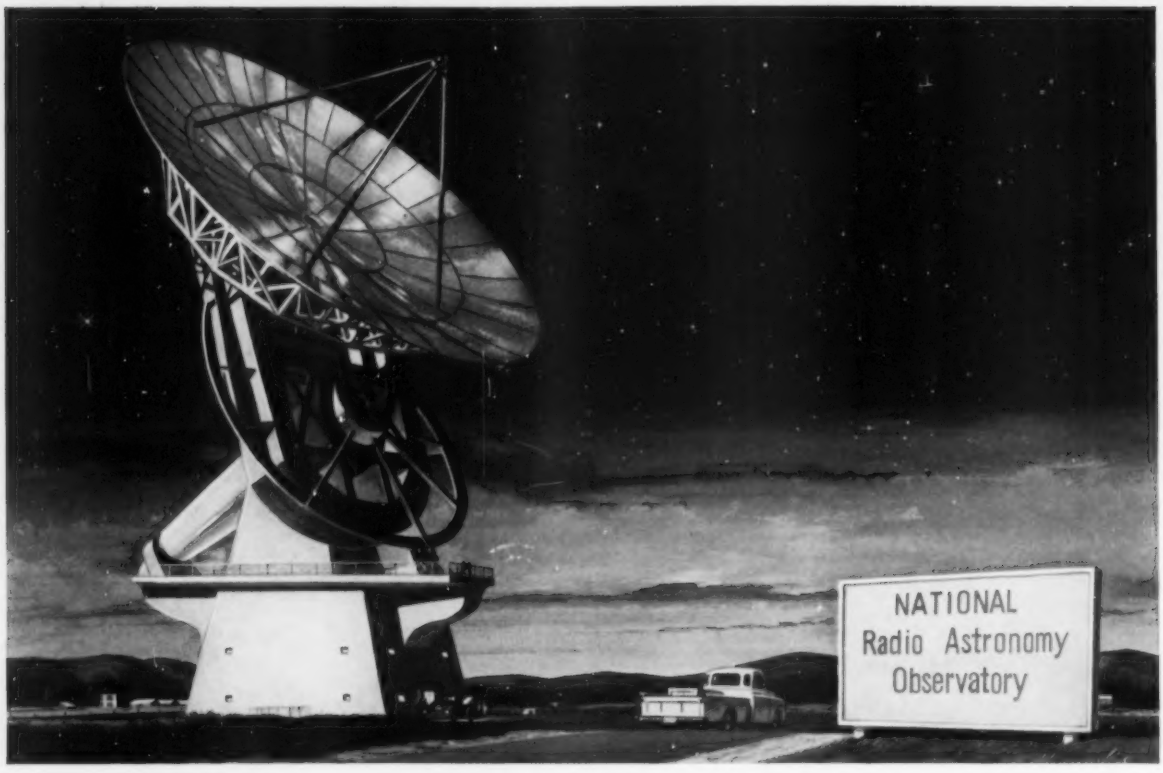
after 200 years:

KEYBOARD LETTER SORTING

see page 40

YARDSTICKS FOR RESEARCH SUCCESS...

see page 34



This radio telescope is now being constructed by the E. W. Bliss Company of Canton, Ohio, at the National Radio Astronomy Observatory at Green Bank, West Virginia. Nickel-alloyed ductile iron is used for support and control parts to achieve watch-like accuracy in guiding the 5-million-pound instrument. The telescope will be operated by Associated Universities, Inc. for the National Science Foundation.

Eavesdropper at the keyhole of an invisible universe

Objects far out in space that cannot be seen with the most powerful optical telescope can now be studied by astronomers.

They do it with an amazing instrument called the radio telescope which can detect radio waves coming from objects that may be as much as *5 billion light years away!*

It may sound fantastic, but that's exactly what this 140-foot telescope at National Radio Astronomy Observatory will do. And although its moveable parts weigh close to 5 million pounds, watch-like accuracy is being built into every foot, every pound.

Take the cannon-like polar axis shaft, which can be seen pointing skyward in the picture. Sixty-seven feet long and 12 feet across, this shaft will be driven by a gear 85 feet in diameter and a foot thick, with teeth machined to be accurate to within thousandths of an inch.

They'll stay accurate, too. For these parts, as well as the 8 bearing pads supporting the massive assembly, are made of nickel-alloyed ductile iron, a remarkable metal developed by Inco research.

It is Nickel which gives this alloy the extra strength and wear resistance without loss of toughness needed for these parts. Unlike ordinary cast iron, nickel-alloyed ductile iron is not brittle. It can be bent or twisted. It is several times stronger than cast iron, yet easy to cast and machine.

Don't forget nickel-alloyed ductile iron even if you're not thinking of building a radio telescope anytime soon. This versatile metal has hundreds of applications in every industry.

So do Nickel and other Nickel Alloys. Be sure to consider them whenever you need a metal with superior ability to withstand destructive service conditions. And don't hesitate to call on Inco for any technical data or other help you may need. Our booklet, *Engineering Properties and Applications of Ductile Iron,* is typical of the informative material that can be yours for the asking. Write for a copy.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

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NICKEL MAKES ALLOYS PERFORM BETTER LONGER

Coming next week

A Product Engineering SPECIAL REPORT

STRUCTURAL MODELS—

How they preview stress and strain

Designers of machines and components—anything from bolts to bulldozers—have taken a cue from the structural engineer and extended the theory to missile components, metallurgical tests, as well as much smaller scale mechanical strength problems.

Our report is in three parts—each by an experienced model analyst in the Mechanical Engineering Department of Battelle Memorial Institute.

PART I—Theory of Similitude

These relationships assure that the model acts like the real thing.

PART II—Novel Modeling Materials

Unique properties of these common materials make better models.

PART III—The Model at Work

How to apply the loads and measure their effect.

Don't miss this report in next week's DESIGN issue for October 26.

and in addition next week

the DESIGN issue

for October 26

FEATURES:

- **Pressure losses in pneumatic systems**
  Nomograph method extends NBS "flow-factor" technique for pressure drops in series.

- **Work-hardened sheetmetal**
  This material has striking advantages as well as liabilities. Here's how to use it in design.

- **Today's diaphragms**
  The newest coatings and fabrics with a selection chart to guide you to the right choice.

- **18 ways to control gear backlash**
  An illustrated sampler of antibacklash devices you can use.

- **21 clamps for wire and cable**
  A special survey of clamps available for a variety of design requirements.

Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news issue

October 19, 1959 Vol. 30 No. 43

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Product Engineering ..... SIDELIGHTS

R and D RESEARCH and DEVELOPMENT news issue

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● **The Post Office modernization program,** the first in its history, is bidding fair to regain some of its lost glamor. Perhaps you remember reading about the derring-do of post riders in the face of Indian scalping squads. They were brave men. The first attempt at setting up a mail system was less romantic. It was made in Paris in 1653, but vandals messed up the service by emptying mail carriages and stuffing mail boxes with paper. The English ran into the same problem some years later, but this time the officials were prepared. The delinquents were hired–and became the world's first postmen. We wondered whether our own delinquents might not be used in some similar way.

● **The new mail sorter** (p 40) may give you an impression of technological progress in our government. However, we read, the other day, of Project ORCON, "the code name for a study the Navy has kept under secret wraps for the past six years. [We're not surprised.] The term ORCON is a contraction of 'organic control,' which, in turn, is a euphemism for using pigeons as a means of guiding missiles." The whole idea was to put a pigeon in a missile, focus the approaching target on an electrically conductive glass screen, and have the pigeon peck away at the image to provide error signals for the missile guidance system. Results were relatively lousy but the psychologists who worked on the project must have had a ball.

● **An additional yardstick of research success** (p 34) was suggested by a news report from Rocket Power Inc, a new company formed to build solid-propellant rocket motors. The company sees application of its rockets in catapult seats, rocket-sled test work, starters for jet engines, metal forming, and fracturing of oil wells which are worn out. All this is very commendable, but the most significant application of all was nearly buried in the report. Rocket Power Inc foresees application of solid propellants in toys for children. If this is successful they can probably forget all that impressive missile and space stuff and settle down to the business of making money. We'd be their first customers.

ABP October 19, 1959

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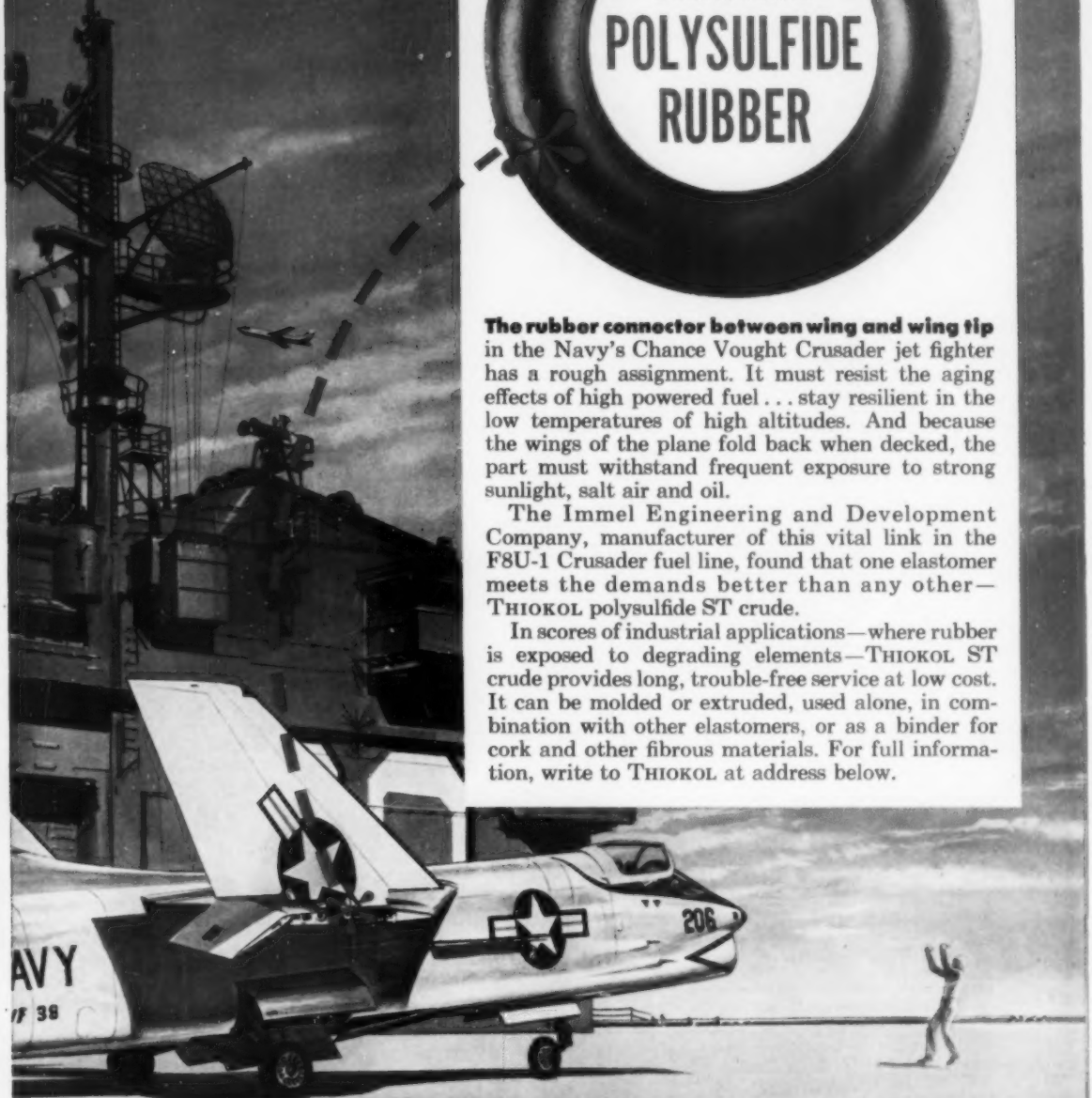
For the vital link
in a line
that must not fail...

The rubber connector between wing and wing tip in the Navy's Chance Vought Crusader jet fighter has a rough assignment. It must resist the aging effects of high powered fuel . . . stay resilient in the low temperatures of high altitudes. And because the wings of the plane fold back when decked, the part must withstand frequent exposure to strong sunlight, salt air and oil.

The Immel Engineering and Development Company, manufacturer of this vital link in the F8U-1 Crusader fuel line, found that one elastomer meets the demands better than any other—THIOKOL polysulfide ST crude.

In scores of industrial applications—where rubber is exposed to degrading elements—THIOKOL ST crude provides long, trouble-free service at low cost. It can be molded or extruded, used alone, in combination with other elastomers, or as a binder for cork and other fibrous materials. For full information, write to THIOKOL at address below.



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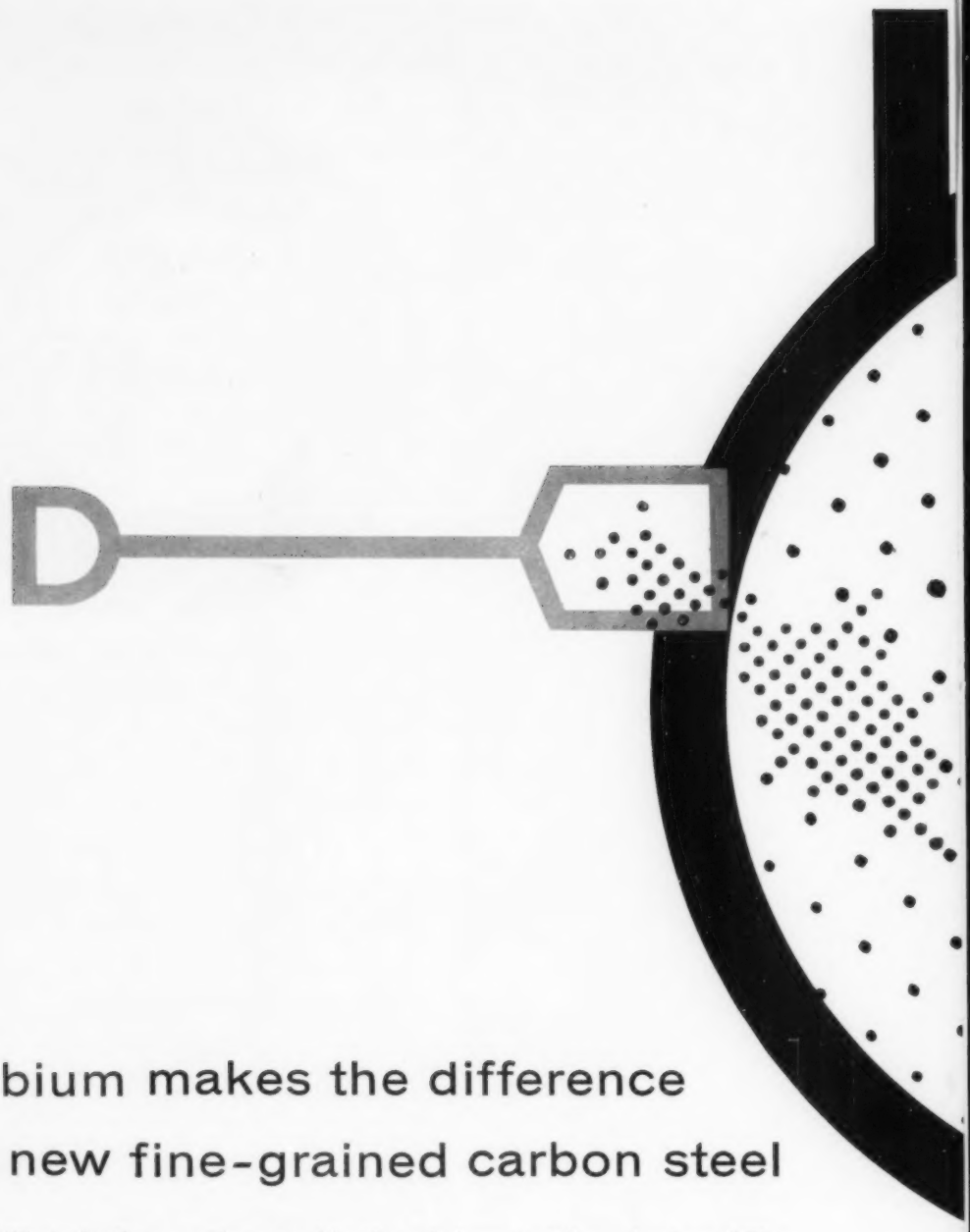


Columbium makes the difference in this new fine-grained carbon steel

The new GLX-W steel offers a unique combination of characteristics—the formability and weldability of mild carbon steel *plus* greater tensile strength and notch toughness.

The addition of small amounts of columbium gives GLX-W the finer grain structure that makes this possible.

Where design permits, the use of GLX-W can result in weight savings up to 35%, compared with mild carbon steel. With yield strengths ranging from 45,000 to 60,000 psi, GLX-W steels are recommended for a broad range of applications. For technical information, write to our Product Development Division, Department C.

GREAT LAKES STEEL

Detroit 29, Michigan

A DIVISION OF NATIONAL STEEL CORPORATION

GLX-W

CIRCLE 7 ON READER SERVICE CARD

DEVELOPMENTS TO WATCH...

American

New enameling process . . .

. . . that permits direct application of porcelain to steel, gives results comparable, and "in many ways superior to" the bond and finish obtained with two-coat applications. It is being readied for commercial introduction by Chas Pfizer and Co.

Key to this process is substituting citric acid for the conventional sulfuric-acid pickling bath—a change that, Pfizer claims, leaves the surface in good enough condition not to need a primer coat. Pfizer also says the process is adaptable to standard processing equipment and the company believes it is "economically sound."

Dry-film lubricants that stand 1200 F . . .

. . . for 24 hr or more, and provide satisfactory ball-bearing lubrication at temperatures to 750 F for at least 240 hr, are being demonstrated at Naval Air Material Center.

These are MOS_2-graphite formulations with an inorganic (sodium silicate) binder (*PE*—Apr 27, *p* 19). E. R. Lamson and M. J. Devine of NAMC report they have excellent low-temperature, nuclear, and vacuum characteristics. They'll stand liquid oxygen; and preliminary irradiation tests indicate they will perform satisfactorily "at radiation levels which transform grease-type lubricants into brittle solids." Important for the Space Age, too, is the fact that the new materials can be used at low pressures such as those found in outer space (see p 14).

(Note: For news of other work on dry-film lubricants see *PE*—Mar 16, *p* 25 and Sept 14, *p* 35, and earlier references.

Quenching raises the yield point of molybdenum . . .

. . . but reduces the amount of plastic deformation to fracture, say W. Liebman, A. Lawley, and P. Maddin of U of Pennsylvania. But, on aging at room temperature, for about 30 hr, the yield point falls back again to its original value, while total elongation never quite recovers.

Strangely, they find the metal is ductile immediately after quenching; brittle 30 min. later; and then ductile again after about 2 hr.

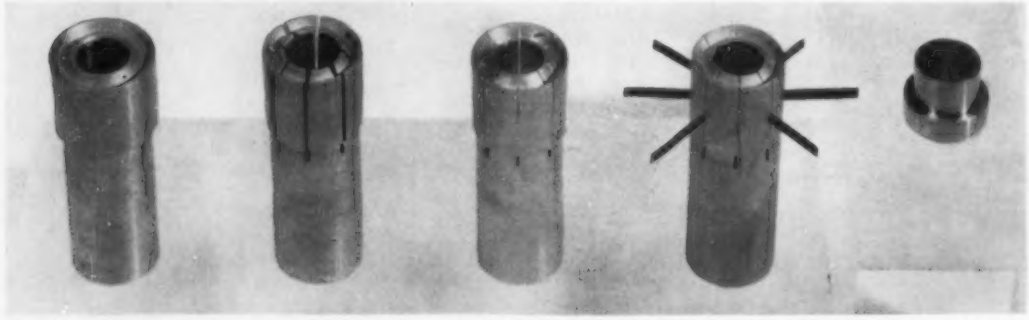
Tests were made on molybdenum wire, heated in a hydrogen atmosphere to 4150 F, and quenched to room temperature in water.

A full report will be delivered at the Fall Meeting of the Metallurgical Society (AIME).

Narrow slots so uniform . . .

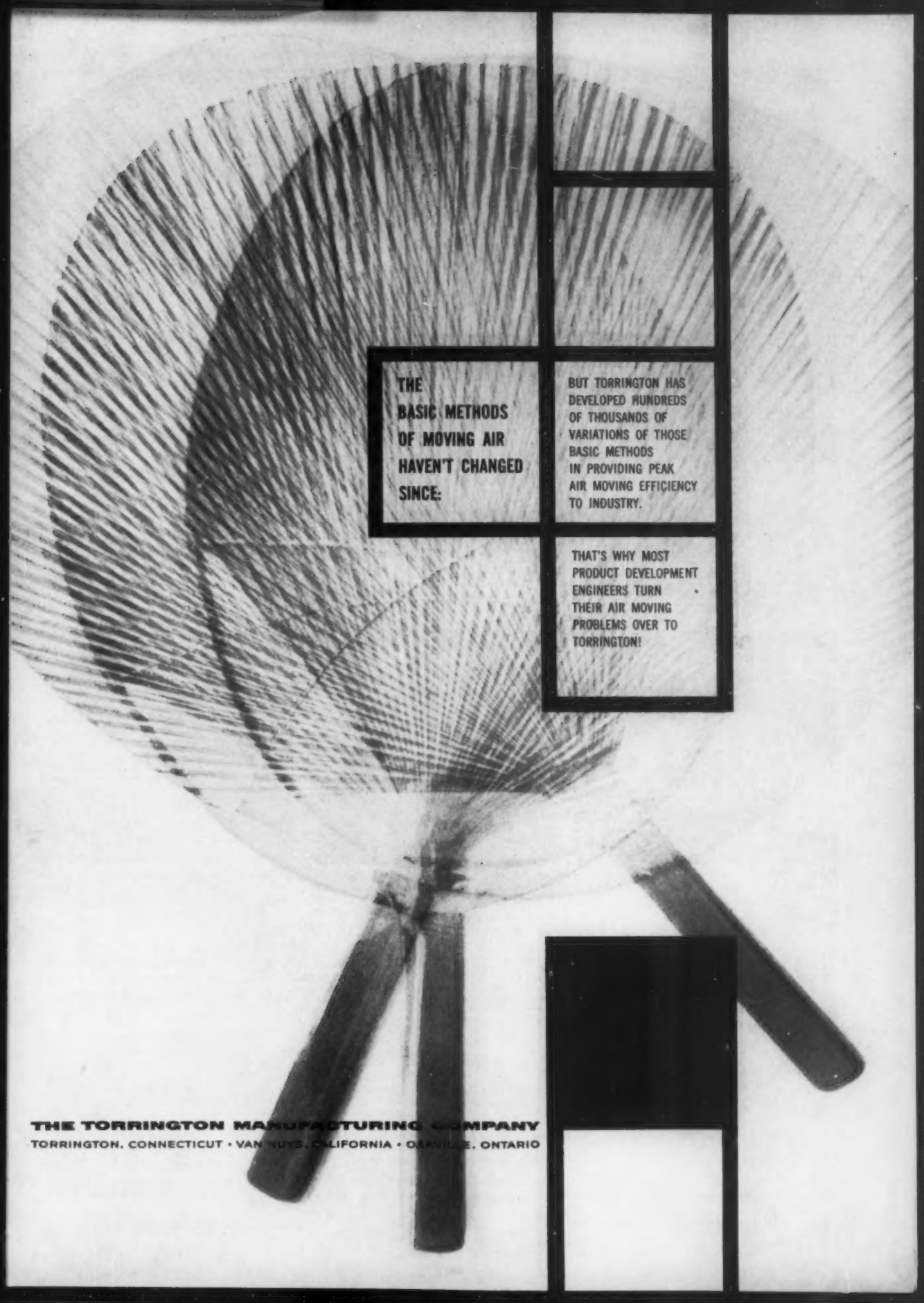
. . . that fins and blades can be brazed in place without alignment jigs are achieved by an unusually simple, low-cost process at Naval Research Lab. First, slots (in copper tubing) are machined slightly oversize. Then, the tubing is forced through a steel die. NRL engineers developed the technique for producing microwave tubes; but think it may have much wider application.

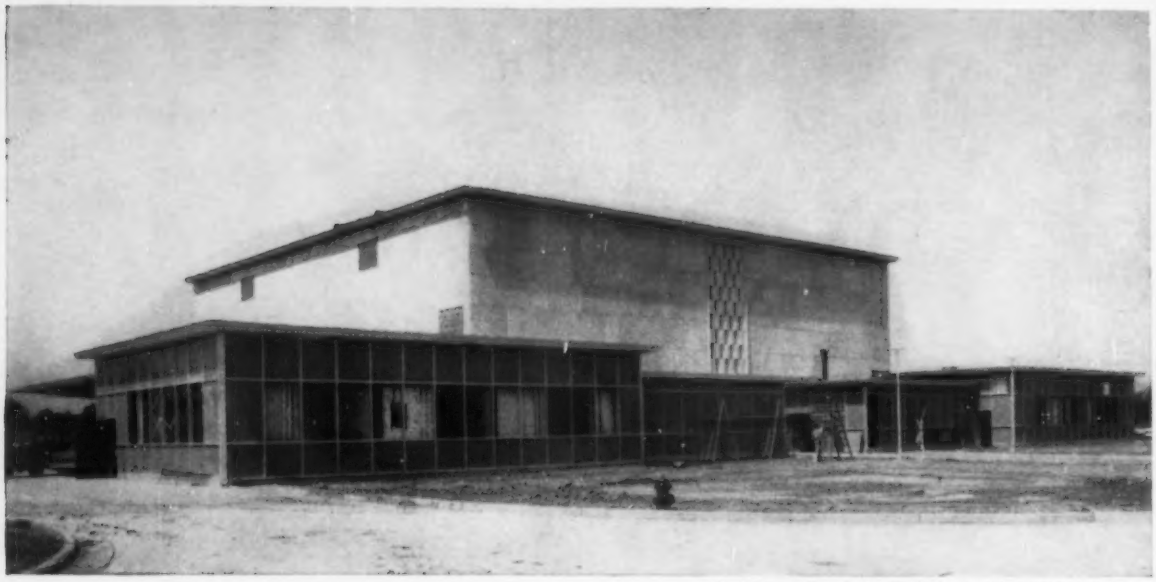
For the microwave grids pictured, slots were cut with a 0.008-in. circular saw; then compressed to 0.001 in. Depth of cut is 0.050 in. Vanes are of tungsten ribbon, 0.001 by 0.030 in. —ARG



Step-by-step pictures show how narrow slots are produced by machining slots oversize, then compressing the tubing (with a steel pin as mandrel) by drawing it through a cylindrical steel die.

CIRCLE 9 ON READER SERVICE CARD→


THE BASIC METHODS OF MOVING AIR HAVEN'T CHANGED SINCE:
BUT TORRINGTON HAS DEVELOPED HUNDREDS OF THOUSANDS OF VARIATIONS OF THOSE BASIC METHODS IN PROVIDING PEAK AIR MOVING EFFICIENCY TO INDUSTRY.
THAT'S WHY MOST PRODUCT DEVELOPMENT ENGINEERS TURN THEIR AIR MOVING PROBLEMS OVER TO TORRINGTON!
THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • ORVILLE, ONTARIO



Architect: Voorhees, Walker, Smith, Smith & Haines
Contractor: Frank Briscoe

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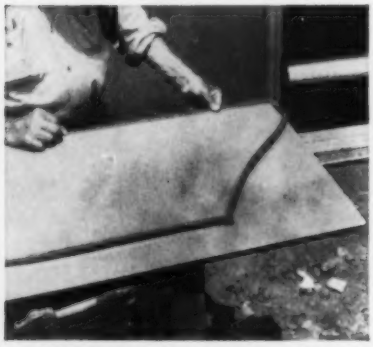
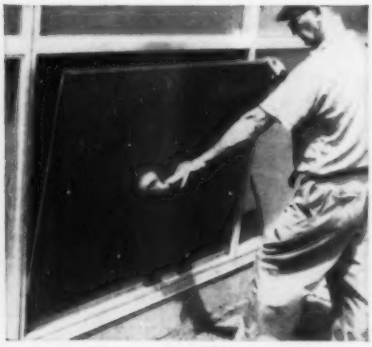
solves weather problem and seals for sure!



Easily installed — Butyl preformed gaskets can be installed on-site or in the shop. They protect panel edges during handling.



Faster glazing — installation of lights is done quickly and more efficiently when edges are protected by Butyl preformed gaskets.

All-around weather protection — the superior resistance of Butyl to ozone, sunlight, heat and moisture provides a sure seal.

Modern mullion, sill and transom design requires highly efficient sections that insure a reliable sealing job. Low-cost Enjay Butyl rubber enables the design of trim, neat window details – provides a permanent weather-tight seal. In this application Butyl does a better job than conventional rubbers because Butyl gives superior resistance to ozone, sunlight, heat and moisture. This means Butyl resists cracking, crazing and loss of elastic properties.

Butyl preformed gaskets and spacers installed in this large research center located at Florham Park, N. J. were manufactured by Pawling Rubber Corp., Pawling, N. Y. For more information how Butyl rubber can help solve your design problems, contact your nearest Enjay office.

Enjay's extensive laboratories and expert staff are always glad to provide technical assistance.

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ENJAY® BUTYL

DEVELOPMENTS TO WATCH...

World-wide

Tungsten-rhenium alloy wire for thermocouples . . .

. . . and other electrical applications is going into production at AEI Lamp & Lighting Co, Leicester, England.

First size to be offered commercially is 0.015-in. dia, priced at $10/ft. That's quite expensive; but, as AEI points out, in addition to increasing tungsten's ductility (see p. 16), rhenium markedly improves its elevated-temperature properties. Result, AEI says, is the new wire can serve as a thermocouple "at considerably higher temperatures than any other known materials." Furthermore, the couple exhibits a high emf (more than 40 millivolts at 5500 F) and an almost linear temperature calibration up to at least that point; and is suitable for use in vacuum, hydrogen, nitrogen, or argon.

AEI is ready to supply it in "any reasonable quantity" and furnishes a calibration chart (temperature vs emf in millivolts) with each batch.

Titanium's top operating temperature climbs another notch . . .

. . . as Imperial Chemical Industries, London, Eng., announces a six-component alloy said to have an ultimate tensile strength better than 100,000 psi at 932 F and an elongation of 19%, with improved room-temperature properties as well.

Primary additives are tin and zirconium, but the alloy also has small percentages of aluminum, molybdenum and silicon. First applications for the new titanium alloy are in jet-engine compressor disks and blading.

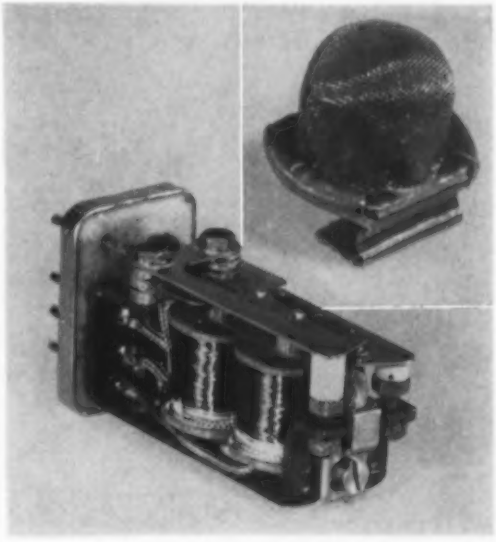
Centrifugal fans with an efficiency better than 90% . . .

. . . are claimed by Bronswerk, Amersfoort, Netherlands; and the company believes the figure can be boosted still higher, particularly for large fans (over 20 in.). As Bronswerk points out, the unbalancing effect of variations in welding is proportionally smaller for the larger wheels; and the frictional area hit by the air decreases proportionally. Nevertheless, it has been demonstrated that improvements in aerodynamic design can bring even relatively small wheels, running at speeds of 1800 rpm or less, into the 90% efficiency range—an improvement of 15 to 20% over the present average.

A miniature, hermetically sealed low-current switching relay . . .

. . . made almost entirely of inorganic materials, and incorporating an unusual "getter" to handle the organic vapors that do form, is now going into production in England. These are 2-coil units, operating at 1.2 to 48 v dc (resistances range from 2.2 to 1700 ohms) and have a single changeover action, with platinum contacts. They can be designed to break within ¼ millisec, close within 1 millisec. Dimensions are on the order of ¾ by 1⅛ by 2⅛ in., and weight is about 2½ oz.

Information on the new units may be obtained from Associated Electrical Industries Export Ltd, Siemens Edison Swan Telecommunications Div, Woolwich, London SE 18, England. —ARG



Activated-carbon getter is key feature of new relay design. Carbon particles are held on cellulose fibers and formed into pellets inserted in the phosphor bronze capsule pictured, much enlarged, at upper right. With this getter, the company says, the relays easily pass 3000-hr life tests, and some have exceeded a billion cycles in continuous operation.

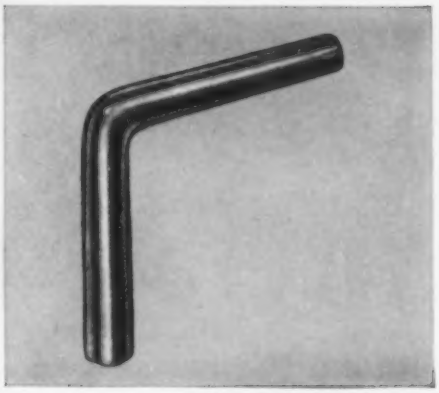
After a full year
of testing,
King O' Lawn* specifies
Fatigue-proof steel bars
for clutch shafts
..saves 25%!

Stressproof for shrub bars
..saves 30%!

*King O' Lawn, Inc., South Gate, California, manufactures the nationally known King O' Lawn power mowers and power edgers

This patented clutch shaft is made of . . .

King O' Lawn
21" home power mower



This shrub bar is made of . . .

La Salle fatigue-proof® STEEL BARS

MADE BY e.t.d.® PROCESS

Elevated Temperature Drawing

FATIGUE-PROOF replaced leaded 4140, heat treated to Rockwell 34-35 C. Result: an over-all saving of 25%!

If you're making parts requiring strengths in the tensile range of 140,000 to 160,000 psi, you'll be interested in these cost-reducing advantages of LaSalle FATIGUE-PROOF:

No heat treating necessary . . . no cracks, warpage, or other problems associated with heat treating.

Faster machining . . . 25% faster than annealed alloys; 50% to 100% faster than heat treated alloys.

Exceptional uniformity from bar to bar, size to size, lot to lot.

PLUS excellent wearability, resistance to fatigue, and dimensional stability.

La Salle STRESSPROOF® STEEL BARS

WITH COPPER

STRESSPROOF replaced C1045 and eliminated heat treating and related operations. Result: production costs reduced 30%.

If you're producing parts that call for minimum yield strengths of 100,000 psi, you'll want to know more about these important benefits of STRESSPROOF steel bars that will enable you to improve quality, cut production costs:

STRESSPROOF means high strength without heat treating . . . it replaces steels such as .40 carbon alloy, as well as other heat treated and alloy steels, such as 8640, 4140, C1045, C1141 and C1137.

Excellent machinability. STRESSPROOF machines at a 140 SFM average rate . . . or at 83% the speed of B1112.

Wearability without case hardening. STRESSPROOF often eliminates the need for case carburized or cyanide hardened steels . . . replacing steels such as C1117, C1118, C1016, C1018, 4615, and 8620.

La Salle STEEL CO.

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Use this coupon to request technical bulletins describing LaSalle FATIGUE-PROOF steel bars . . . and LaSalle STRESSPROOF steel bars.

☐ Please send new bulletin, "Today's improved LaSalle STRESSPROOF Steel Bars with copper."

☐ Please send 24-page booklet, "A New Material," which presents the results of more than one year's test of production samples, and reports on eight application case studies.

Name_____

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CIRCLE 13 ON READER SERVICE CARD

WHAT'S HAPPENING IN... Science

Free radicals take a back seat

Free radicals—the highly reactive molecular particles that once seemed an excellent energy source for space propulsion—no longer look as promising as was originally thought. That's the consensus of scientists who worked on the NBS "crash" program (*PE*—Oct 7 '57 p 15) and of many other leading scientists in the field.

But, reporting at such meetings as the Cryogenic Engineering Conference, the American Chemical Society and the recent NBS-sponsored International Symposium, they emphasize that all is by no means lost.

Investigation of the dissociated, highly reactive molecules holds the key to new physical and chemical reactions, new materials, improved systems for chemical processing, and new fire-fighting techniques.

As James W. Moyer of GE, one of the NBS industrial consultants, puts it, "that the NBS program did not result in a so-called 'breakthrough' for new rocket propellants should disappoint only the space merchants." He says the program resulted in greatly increased understanding of low-temperature phenomena, advances in instrumentation, and many other developments that aid scientific research.

The strange problems of space

The closer we come to space travel, the more practical questions seem to need answering. Recently, for instance, NASA administrator Keith Glennan noted many materials play strange tricks in the vacuum of space.

- Magnesium sublimates—and effectively disappears.
- Moving metal-surfaces, without air between them, tend to weld together by molecular adhesion.
- The impact of micrometeorites poses problems in maintenance of material emissivity—retention of specified heat absorption and radiation in the face of constant surface erosion and cold working by meteoric impact.

Says Glennan: "We have learned we are not nearly as far advanced in space technology as we had thought or hoped." But he has no doubt these problems can and will be solved.

briefs . . .

Reactor-grade steel, with cobalt content held to less than 0.005%, is being produced by 3 Austrian firms; and they say they're ready to export the material. The companies: Austrian Iron & Steel Works in Linz, Gebruder Boehler of Kapfenberg, and Schoeller-Bleckmann of Donawitz. Also available from Boehler: a boron-alloy steel for reactor control rods.

Polyfibron is a new word for your glossary. Right now, it's being used by only one company; but it's not a trademark, and is such a convenient contraction that it's likely to gain much wider use—as have *surfactant* (for surface-active agent) and *syndet* (for synthetic detergent).

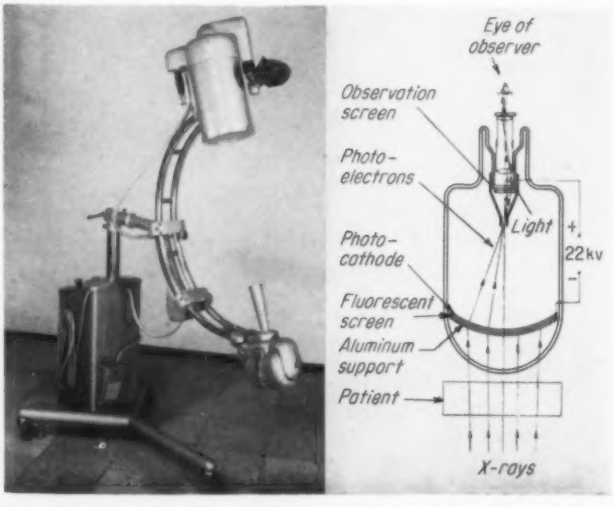
What is Polyfibron? It's a term Dewey & Almy (Div of W R Grace & Co) coined to describe its expanded *polymer-fiber* research program and new polymer-fiber research laboratory. Purpose of the laboratory and the research program is improved resin-impregnated fiber webs and coated materials for use as battery separators, cushioning materials, insulators, and the like. —ARG

Brighter X-ray Images

An X-ray fluoroscope that takes advantage of a lot of new ideas has been developed by Mueller of Hamburg (W Germany) and Phillips of Eindhoven (Holland).

In place of the usual flat fluorescent screen, this has a curved one fixed to an aluminum support, and in contact with a photocathode of the same shape (see diagram). As X-rays impinge on the screen and light is produced, it activates the photocathode, releasing a stream of electrons "proportionate to brightness of the screen at the point in question."

In this way, an electronic image is created. It is projected onto another fluorescent screen with the aid of an electrostatic field. Here, by reversing the process, the electronic image becomes a visible one, enhanced in brightness by the combined effect of concentration on a smaller screen and "acceleration of the photoelectrons in the electrostatic lens." Finally, a microscope is provided for viewing the image at suitable magnification.



Curved screen, with photocathode to match, forms heart of new X-ray fluoroscope. It produces a small, bright image, viewed through microscope.

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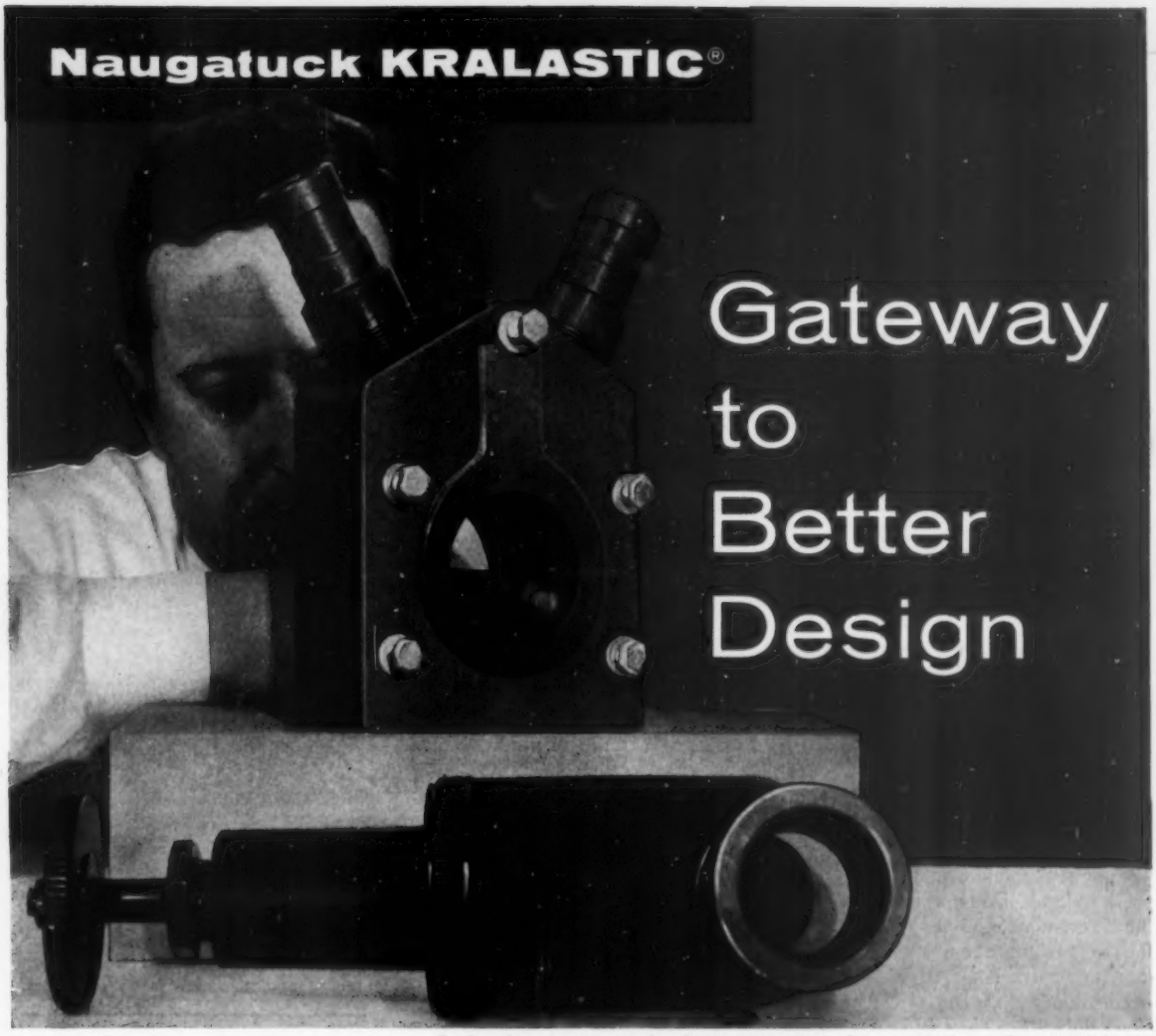

Section of pump and gate valve of KRALASTIC by Vanton Pump and Equipment Corp., Hillside, N. J.

The sealless pump and throttlable gate valve shown above are two of the scores of products recently made better, some even made possible, by the tough and dimensionally stable KRALASTIC rubber-resin.

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WHAT'S HAPPENING IN... Materials

Can tungsten be tamed?

Will alloying help to increase tungsten's workability without destroying its valuable heat resistance and electrical properties?

While much progress has been made in fabricating this intractable metal (*PE*—Apr 6, p 16), much more is needed; and processing alone can't do the trick. But an increasing number of experts on both sides of the Atlantic believe alloying can.

Right now, interest centers on the transition elements (titanium, chromium, and vanadium), with titanium showing the most promise.

Kieffer, Sedlatschek, and Braun of Metallwerk Plansee AG, Reutte/Tyrol (Austria) report that coarse-grained arc-cast alloys, containing up to 8% Ti and fine-grained sintered alloys of 5 to 10% Ti, do show improved hot-forgibility.

Tungsten-tantalum alloys may also prove a fertile field for investigation, the Austrian metallurgists report, since the two metals are completely miscible over their entire range.

Rhenium, too, can increase tungsten's ductility. This is still a rare and costly metal (*PE*—Dec 16 '57, p 6), and rather high percentages (20 to 30%) are needed; but tungsten-rhenium wire is going into commercial production in England (see p 11) and shows definite promise for thermocouple use.

More data on titanium and columbium

First reports on a long-term research program conducted at the Central Institute for Industrial Research, Blindern, Oslo, Norway, but sponsored by our own Air Force, detail oxidation mechanisms and effects for titanium and columbium (niobium) at temperatures to 1830 F.

The reports, both mimeographed and both in English, run to something over 100 pages, complete with charts and illustrations, and are obtainable from CIIR. AF contract numbers are: oxidation of titanium, AF 61(514)-892; oxidation of niobium, AF 61(052)-90.

The hunt for better iron-chromium alloys

Alloys of iron and chromium, with or without aluminum, have many valuable properties—good oxidation resistance at elevated temperatures and valuable electrical and magnetic characteristics. But their brittleness at room temperature has limited their use.

To overcome this limitation Naval Research Lab metallurgists have been conducting a series of studies aimed at uncovering causes and cures.

Findings to date are surprising: Iron-chromium alloys containing up to 24.3% Cr, and iron-chrome-aluminum alloys with 25% Cr and 6% Al show surprising—and, as yet, unexplained—shifts in Charpy-V impact transition temperatures.

When alloys are quenched from 1600 F, transition temperatures decrease with increasing chromium content. But when they are slowly cooled from 1600 F, transition temperatures increase with increasing chromium content.

"The effects," says NRL, "are not readily explained by the known embrittling mechanisms."

When aluminum is added, it, too, has unexpected results. Alloys with about 0.5% Al had "significantly lower transition temperatures than corresponding alloys without aluminum." But those with about 5% Al had higher transition temperatures.

Other findings: manganese—even in amounts to 13%—appeared to have no beneficial effect on transition temperatures, and titanium, in amounts to about 2%, raised the transition temperature.

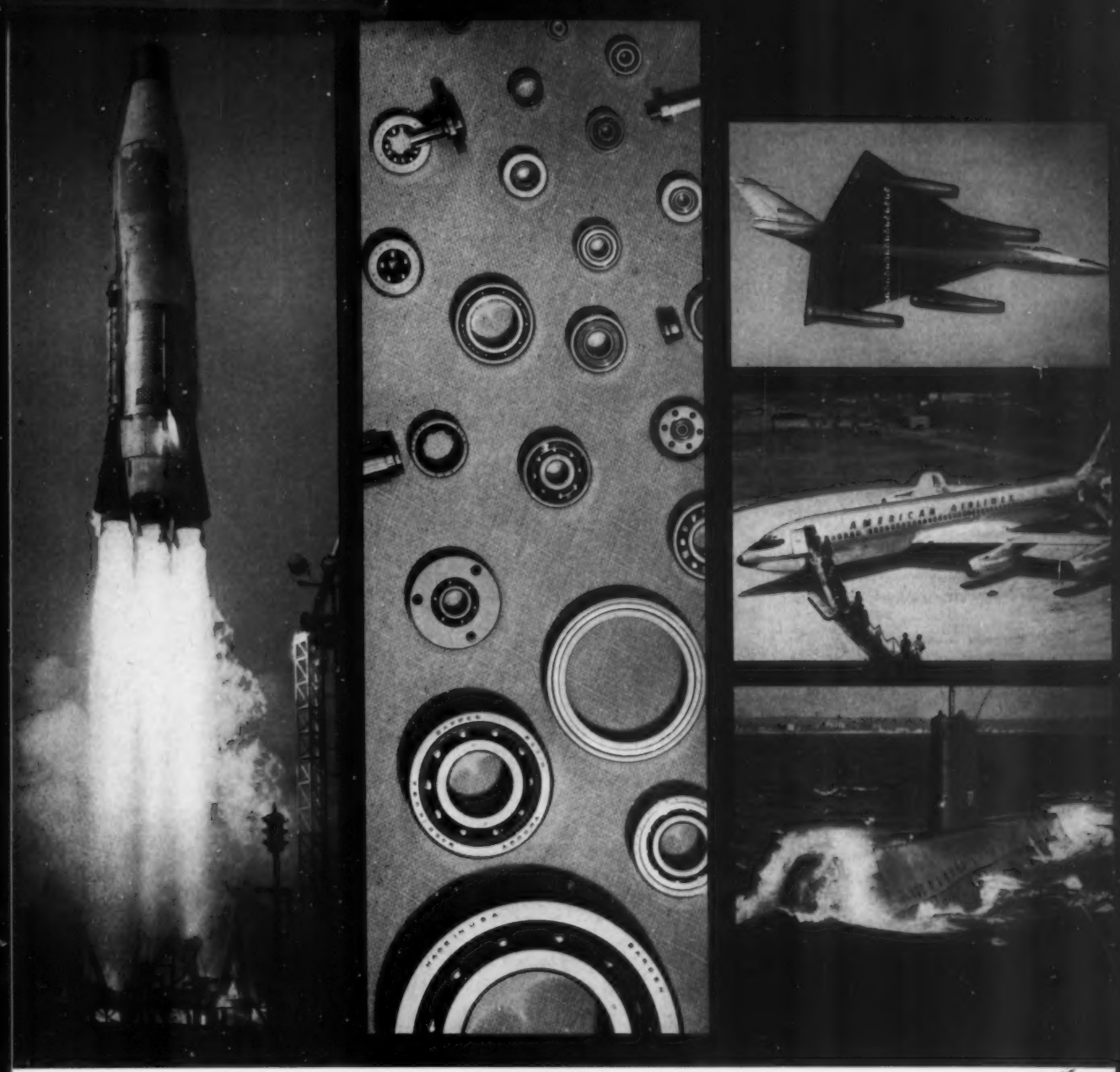
A report (NRL 5367) is being prepared by J. E. Srawley, and will be available in about a month from OTS, Dept of Commerce, Washington 25, D.C. as PB151811. Two earlier reports (NRL 5124 and 5290) on iron-aluminum alloys have previously been published.

Titanium's biggest?

Five-inch Y-pattern valve, one of a series built by Crane Co for service in an ore-processing plant, is proudly displayed as proof of progress in fabrication and application of this "new metal." Valves are designed to handle acid slurries at 600 psi and 475 F, feature cast titanium bodies, ceramic seats and disks.

briefs . . .

Heat resistance and chemical and physical properties of plastics can still be improved considerably by changing the percentage of fillers and using new filling materials, G. P. Sutton of ARPA pointed out to the Armed Forces Chemical Assn. It's well known that fillers can increase strength and heat resistance. But they can improve electrical conductivity and insulating ability as well. Dielectric strength of polyester resins, he says, can be adjusted almost at will with such fillers as titanium oxide. —ARG



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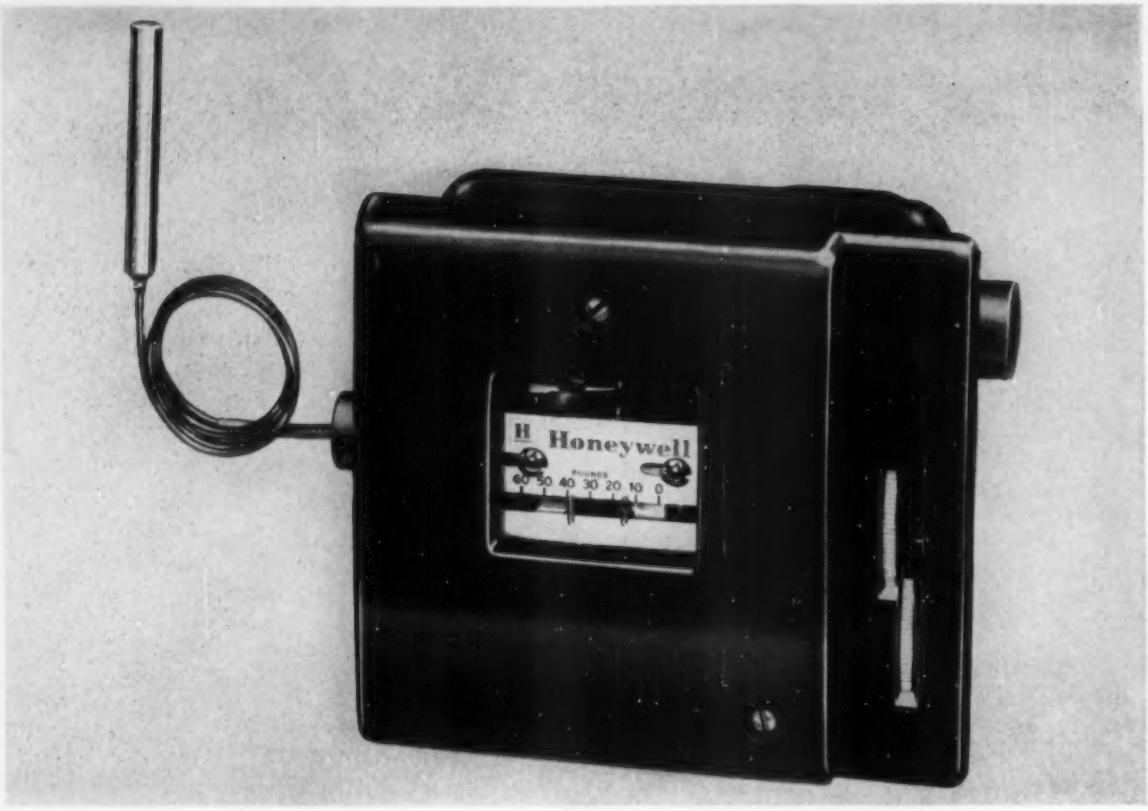

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Product Engineering HORIZONS

October 19, 1959

Too Much **LOYALTY?**

"Yes, Duncan came in, and after pussyfooting around for awhile, he blurted out that he disagreed with his boss' decision on that new whiffletree design. Said he had one of his own that's cheaper and easier to produce and will sell better. Offered to show it to me. But I told him it was out of my hands. If his boss couldn't see it, that settled it. My job is to back up my project supervisors, not to make them trouble. Actually, Duncan's idea *is* better, but we can't have a man going over his boss' head, or the whole organization falls apart."

That's a chief engineer talking, showing what he believes is the essential solid front, giving his group heads the same loyalty he expects from them. And he couldn't be more wrong. The product and the company will suffer because of misplaced loyalty that is really a perversion, a tragic misinterpretation of the meaning of the word.

The primary function of management is to arrive at the best result possible. This must be done in spite of individuals, in spite of tradition. There are times when the best decision will hurt morale, "violate company policy", and shake up the staff generally. But that's part of the job of being a boss. If all the decisions can be made by rote, if all the decisions are the popular and accepted ones, they can be made by computer—no real thinking is required.

Part of the penalty of command is the lonely necessity to decide—and that can be lonely indeed. The staff can advise and suggest, it can make the small decisions—but the big ones—and the unpopular ones—must be at the top. This includes the periodic necessity for overruling subordinate decisions.

Too often, words like "patriotism" and "loyalty" are corrupted by time and alibi artists so the first becomes the last refuge of scoundrels and the second the first preservative for the face of a man in error. What are great and vital concepts in the life of society become cover-up words to deflect any too-penetrating examination of motives and acts.

Loyalty is a very important idea in an organization: it is essential to morale and even to survival. But the concept must be thought-linked, not emotion-linked. Every time loyalty is a criterion, these questions must be asked: Is this just an easy "out"? A substitute for thought, action, or facing facts? A way to cover up bungling? A virtuous-sounding echo to a quietly passed buck? A synonym for something-for-nothing?

Loyalty includes both obligation and confidence, but not infallibility or even belief in infallibility. It can and should survive many kinds of errors and miscalculations, but never self-deception that loses sight of the objective. Loyalty, in fact, should be inherent, neither demanded nor offered. Ostentatious loyalty, like 3-day-fish, begins to smell.

Unfortunately for us all, division of loyalty is common in the engineering profession, where national, company, division, group and personal factors tend to tug and haul. The engineer must, therefore, guard above all the basic loyalties—to the profession, to the job, to the product.

motors for commercial applications

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Chem-milling Cuts Cost As it Contours Honeycomb

WILMINGTON, CALIF.—Dramatic cost reductions in one of the most expensive structural materials—metal honeycomb—are anticipated based on development of a chemical contouring technique jointly unveiled by Turco Products Inc and the Norair Div of the Northrop Corp. Unwanted material is removed chemically rather than by machining. Tooling cost is sharply reduced and rejects almost eliminated, say the companies.

HOW IT WORKS

Picture sequence shows major steps in this process—the first that has been successful on a production basis, and that can handle both steel and aluminum honeycomb. Production tolerances are ±0.005 in.; with special handling, aluminum can be held to ±0.003 and steel to ±0.002.

Major problem according to Eldon Bowman, a Norair research assistant, was in finding a suitable maskant. Characteristics required the material to be easily handled plastic, resistant to etchants, with some rigidity and structural strength but only slightly elastic. Most important: it had to cut like soft cheese when the honeycomb was pressed into it. The vinyl-type maskant selected can be sprayed, brushed or flow-coated on the oven-cured negative.

WHAT CAN BE SAVED

A Norair report compares cost for machining the T-38 landing gear strut door, which is 16 in. wide, 36 in. long and has a ¾-in. original thickness. Final thickness varies from 30 to 67 mils with some areas feathered to 0.0 mils. As can be seen from the table, operations common to both methods are not given, hence costs are a direct comparison of the two contouring methods, according to Norair.

WHAT'S IN THE FUTURE

Norair, convinced it is on the right track, has worked with Turco in developing and testing the special compounds needed. Norair has also:

- Entered into an agreement under which Turco will license the process and make technical information available to interested companies. Detailed specifications will be released by Turco at the National Metals Congress, Dec 2-6, Chicago.
- Started installing facilities for using the process in fabricating honeycomb for Norair's T-38 and N-156F aircraft.
- Increased emphasis on efforts to develop new brazing techniques so that the honeycomb core tolerance that must be maintained for satisfactory bonding to the skin is less critical than at present.

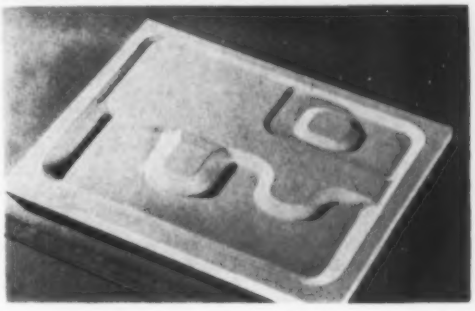
Although conceding that mechanical methods may continue to be more economical for straight surfaces, Turco also points out that this may well be the breakthrough needed to permit using honeycomb sandwich materials in nonaircraft industries where weight and price factors are much more critical than close dimensional tolerances. Consideration is also being given to developing high-speed production equipment in which parts would pass continuously through an etchant spray and to washing and drying areas. Automatic demasking would also be advisable, if production volume is high enough. ■

COMPARISON COST VALUES (T-38 landing gear strut door)

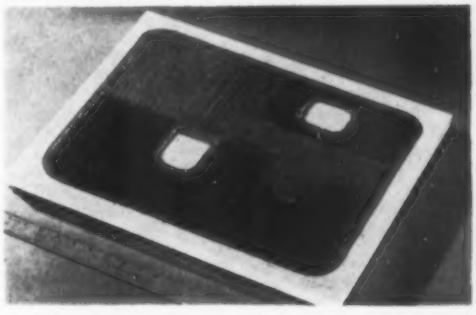
Mfg Method	Total Tooling Cost		Total Comparative Unit Cost			
		TQ—	10	100	500	1000
		RQ—	5	10	25	50
Chemically milled	$800		$280	$133	$93	$83
Machined & crushed	$3500		$619	$208	$137	$120

TQ—Total quantity wanted RQ—Required quantity at one time

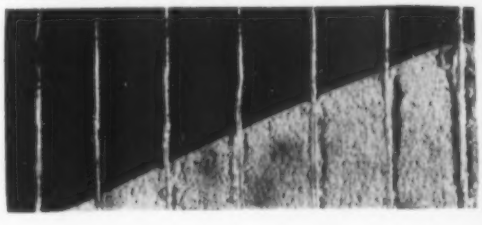
Frangible, plastic-like material makes up negative that is cast from master pattern. Negative is oven-cured, then sprayed, brushed, or flow-coated with a vinyl-type maskant to depth of 10 to 125 mils.



Honeycomb core is pressed through the maskant and into negative. Honeycomb is reinforced by filling the cavity with a hot-melt core-seal.



Cross-section shows honeycomb embedded in the masked negative (light) with the hot-melt supporting plastic (dark) poured into cavity to protect core. Washing away negative permits exposed core to be etched away. Removal is rapid, 5 to 10 min in a 120-to-160 F bath.



Faultlessly contoured honeycomb core for sandwich panel construction is shown after maskant and core-seal are stripped away. At right is master pattern from which negative was made.

Tape-controlled Turret Punch Press
Another Addition for Short Run Automation

WAYNESBORO, VA.—Designed specifically for automation, the Wiedemann Machine Co turret punch press—called Wiedematic—with General Electric numerical-positioning control, is said to give the fastest and most consistently accurate short-run piercing. All functions of this versatile press—tool selection, material positioning, and piercing—are controlled automatically.

Specifications for the machine: 20 to 40 holes per min to an absolute hole accuracy of ±0.010 in. In terms of table and turret motion, this requires an average of 4 in. of table motion in both axes, 30° turret motion, and about 3 turret changes per min. Reliable operation at specified accuracy and hits per min on production parts is obtained at table speed of 600 in. per min; turret operation at 15 rpm.

Hydraulics, pneumatics, electrical and mechanical systems are incorporated in the machine control.

Hydraulics position the worktable with two synchronized cylinders for fore and aft motion, and one for traverse. These give the fast response needed, but require closed-loop servos to keep the fore-and-aft cylinders synchronized for positive positioning.

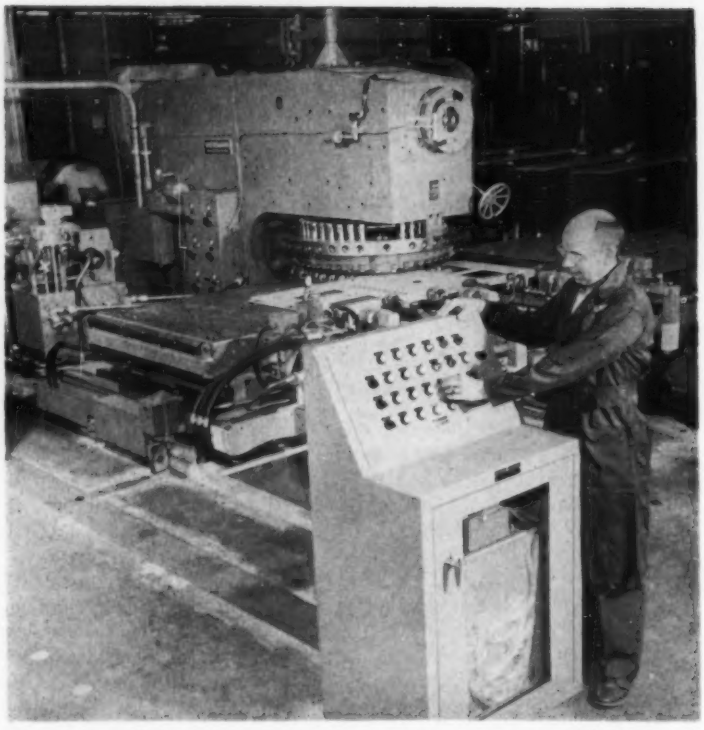
Pneumatics control the turret-locking pins; the turret itself is hydraulically indexed. Air clutch on the hydraulic turret motor slips to prevent excessive torque.

Feedback system is all electrical. Servovalves are used for the hydraulic servos and are paralleled for increased flow. Selsyns driven from rack give voltage signals indicating table position. Proximity-type limit switches are used to withdraw clamps for edge punching.

The modified Mark III numerical-positioning control governs three motions, two linear and one rotary (left-and-right and in-and-out table motion, and turret motion). System is a closed loop, self-checking to a specific tolerance. It operates from zero reference so there is no accumulation of errors. Control accuracy is ±0.005 in.; rotary accuracy is ±¼°. Tape is standard channel, 1 in.-wide, and is advanced to read for next positioning during machine operation.

As an adjunct to the numerical-positioning control, GE has developed an Auto-programmer. Device aids in fast, accurate production of tapes.

In operation, once a part layout is made, using drafting templates, the operator need only center a locating device over centerline markings on the template for the punch desired. A foot switch transfers the X and Y dimensions as measured by the locating device from the layout to storage and readout. A second foot switch causes the information to be punched



Turret punch press . . . completes an automatic sequence of loading and piercing holes at a rate of 30 hits per min. Press can handle 60 x 100 x ⅜ in. plate or sheet. Control console can be placed at any convenient location. Automatic control increases machine productivity as much as five times over that normally obtained with manually operated presses of equal capacity.

Auto-programmer . . . produces a tape from dimensionless engineering line drawing, using an optical system. Drafting time is reduced 75%. Equipment includes tape preparation board, control station, motorized tape punch (housed in control station), and half-scale Cronaplex templates. Tape preparation board is a Haag-Streit Coordinatograph; on it are mounted two Fisher-Porter Digi-coders, one each for the X and Y motions.

on tape. Machine head positions are selected by manual operation of selector switches on the programmer's control console.

A Diazo transparency is made of the layout, and after part numbers and drawing numbers are added, the transparency becomes an assembly drawing. ■

High-speed Color Film to Record Tech Data

ROCHESTER—A high-speed color motion picture film expected to be useful in recording all types of technical data under unfavorable lighting conditions (particularly in missile tracking, flame and aerodynamic studies) has been developed by Eastman Kodak Co.

According to Eastman engineers, the film is fast enough to track a speeding missile, and sharp enough to pinpoint seemingly indistinguishable changes in flame patterns. New film has a normal exposure index of 160 (16 times as sensitive to light as Kodachrome movie film), and for missile data recording it has been exposed at indexes up to 500.

Called Daylight-balanced SO-260, it can—at a shutter speed of 1/50-sec at 24 frames per sec sound speed with a lens aperture of f/1.4—be exposed at the normal 160 rating with only 14-ft-candles of incident illumination.

Almost as sensitive is the SO-260's tungsten-balanced (artificial light) companion, the SO-270, which has normal exposure index of 125. ■

Educators Experiment with Engineer Curricula, Offer More Science, Less Hardware

DETROIT—An experimental approach to engineering education at the college level is being conducted at Michigan State University — Oakland, (MSUO), whose first graduates are slated to receive degrees as Bachelors of Engineering Science.

Program is essentially a 3-to-4 year orientation in engineering science followed by a year of specialization in either of two general fields: (1) electronics, circuits, electromagnetics and system studies or (2) properties of materials, heat transfer and mechanics. Course integration, emphasis on math and science, and avoidance of "hardware" courses, is foundation for the MSUO program. Other schools are attempting this program but only on a partial basis (*PE*—Aug 31, p 19).

Technical work during the first two years is devoted to chemistry and physics. Engineering fundamentals are offered in the third year. Math studies are continued during the first three years and will include differential equations, Laplace transforms, partial differential equations, special functions, and functions of a complex variable.

Other courses not generally associated with an engineering curriculum are history and development of western civilization, composition and literature, social science, history and philosophy of science, foreign studies, and "Great Issues."

A panel of five leading engineering educators helped to organize the program—Dr Eric A. Walker, president of Pennsylvania State Univ; Dr C. Richard Soderberg, dean of engineering, MIT; Dr Lee A. Dubridge, president of California Institute of Technology; Dr Newman Hall, professor and chairman of Mechanical Engineering, Yale Univ; and Dr Frederick E. Terman, dean of engineering, Stanford Univ.

This group decided that needs for engineering personnel during the next 50 years can be classified into three groups: (1) the innovators and directors; (2) the applicators; and (3) the technicians. Accordingly, curricula of established engineering schools do an adequate job of preparing the applicators—those engineers who take the ideas of others and design the machinery for their implementation. The need for technician training will probably be met by current plans for development of technical institutes in connection with local community and junior colleges. But the panel was alarmed by the need for a school to educate the innovating and directing engineer.

A LOOK AT THE NEW ENGINEER

They agreed that to head vast, complex and integrated engineering projects of the future, the new engineer must have a scope and range quite beyond that required by the average practitioner up to now. He must understand the fundamentals of all branches of engineering, assign respon-

(CONTINUED ON PAGE 24)

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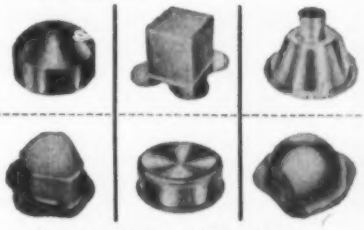

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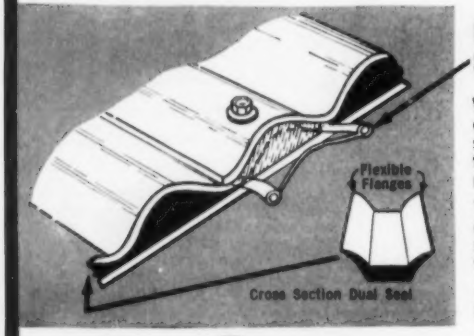
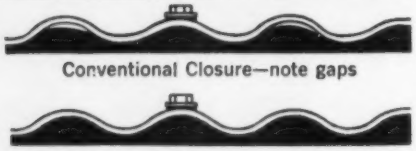


DUAL SEAL Vinyl Side Lap Sealer

Widely used with translucent plastic corrugated sheeting in preference to adhesives, or unsightly mastic.

The "air cushion" beaded edges provides permanent seal—while permitting light transmission.

1", 2", 3" widths available in 50' rolls.



Conventional Closure—note gaps

DUAL SEAL—complete weather tight conformance. Costly and messy calking is eliminated—no clean-up to remove unsightly appearance.

Specify DUAL SEAL with CONFIDENCE—Years of usage on industrial structures proves its merit. (Job details on request.)

DUAL SEAL* is available from stock in most corrugation sizes. By eliminating calking, the installed cost per square is frequently cheaper than conventional closure. No waste—no breakage—no sagging. Resists arctic or tropical temperatures with equal satisfaction.

Bulletin and Samples on Request

*Trade Mark

Patented in U.S. and Canada

FABCO

FABRICATED PRODUCTS CO.

West Newton, Pennsylvania

manufacturers of "Topseal System of Structural Fastening"®

(CONTINUED FROM PAGE 23)

sibility to specialists in the various engineering disciplines, and administer and coordinate the efforts of these specialists. Too, he must be able to deal with people outside the engineering field: he must communicate with lawyers, financiers, politicians, people who can't be reached on the basis of formulas and blueprints.

They said the innovating and directing engineer must have an understanding of his society in which he may be working, or for whose consumption and benefit his particular project is intended. Hence, the need for a thorough grounding in the philosophy and background of our own civilization as well as the civilizations of peoples who look to us for leadership, or with whom we might be competing on the world markets.

PROGRAM FOR THE GIFTED

The panel agreed that there are at present, too few students with the intellectual ability and willingness to work that's needed to become members of the innovating class.

Accordingly, a candidate for admission must now be a graduate of an approved highschool and must have been in the top half of his graduating class. He must also meet certain entrance requirements and be recommended by his principal as a sound college risk.

BEHIND THE PROGRAM

The new college campus is 12 miles from the GM Technical Center, 12 miles from Ford's new proving ground and test center, and less than three miles from Chrysler's proposed new research center.

It is built on an estate donated by Mr and Mrs Alfred G. Wilson, and it has a "Foundation" that includes active and retired top executives of the automotive industry, who along with the educators can be expected to keep tabs on the program's progress. ■

Japanese Apply Export Design Law

Tokyo—To help clamp down on Japanese piracy of foreign products and also protect domestic manufacturers, the government has approved enforcement of the Export Goods Design Law, effective the first of this month.

The law is applicable to all non-

members of Japan's Sundries Export Assn. This group controls price, volume, and designing of export goods to prevent excessive competition among its members, and they have long been regulated. Now, nonmembers will be controlled as well.

The law now provides three steps for a wide range of sundry goods manufacturers outside the association who want to export their products. First, application is submitted to the Ministry of International Trade and Industry (MITI) for approval by the Examination Council. Second, upon approval, registration is established at a nominal fee of $3. Third, registration has to be renewed every 6 months with remittance of $1.50. ■

US Education Relations Abroad Being Studied

NEW YORK—Creation of an independent national committee to study the participation of American universities in international education, research, and technical assistance has been announced by the Ford Foundation. The new group, known as the Committee on University and World Affairs, consists of nine leaders from US universities, government, business, and foundations. Its chairman is Dr. J. L. Morrill, president, Univ of Minnesota.

The committee, in a report it expects to issue in 1960, will explore how the traditional concept of the American university can be adapted, in principle and in practice, to present-day relations of the US with other nations. In preparing its report, the committee will examine the educational and research work of universities related to international affairs, the role of the universities in assisting foreign countries to develop educational and research institutions, and the cooperation of universities in government technical-assistance programs, and in programs for the exchange of students and faculty.

In announcing the program, Ford Foundation officials pointed to post-WW II expansion of international interests on the part of US universities. They cited statistics compiled by the Institute of International Education—47,245 students from 131 foreign countries were studying on American campuses in 1958-59. In addition,

(CONTINUED ON PAGE 26)

80% More Capacity—Far Less Space

HI . . . in capacity — will handle up to double the load.

HI . . . in versatility—More load with no increase in size or weight.

HI . . . in performance — Fin and fan cooled for greater capacity with less heat rise.

HI . . . in value — all new design for long life and minimum maintenance.

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Manufacturers of gears and speed reducers - both stock and special

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CIRCLE 25 ON READER SERVICE CARD

New UNION readout instruments withstand shock, vibration and extreme temperature changes

Union Switch & Signal's new READALL* readout instrument replaces complicated systems of lights and relays for reading, storing or transferring all types of information for industrial and military applications. It is not to be confused with conventional indicating devices.

Designed to meet requirements of MIL-E-5422D. The new READALL readout instrument is precision-built and provides instantaneous and continuous operation under conditions of shock, vibration and extreme ranges in temperature. The digital display includes characters in numerical sequence from 0 to 9 plus two blank spaces. 7/32-inch characters can be illuminated red or white as desired; when not illuminated, they appear white against a black background.

Reliability. Performance through one million random operations is an inherent feature of the new READALL instrument. Each module is gasket-sealed in its case to exclude moisture and seal out foreign particles. An especially thin enclosed DC motor, containing ball bearings, permits more efficient operation.

Modular Construction. A unique feature of the readout instrument is its modular construction. It can be used individually or in groups to display multiple characters in a single case.

Direct Code Translation. The operation of the READALL readout instrument is based on a positioning system using a four-bit code. The visual display is the result of a direct electro-mechanical conversion of a binary signal to a decimal read-out. There is no need for additional conversion equipment. Separate code and motor circuits permit the use of the readout instrument in low-level circuitry.

Electrical and Visual Data Storage. Once positioned, the information is displayed until a new code is transmitted to the instrument. No power is consumed while the information is retained. This data may be stored or read-out electrically for further transmission or recording.

Operate Time. The operate time varies from 0.1 second to 1.0 second depending on character position.

Weight and Size. Maximum weight including case is seven ounces; without case, four and one-half ounces. Size encased is 5 13/64 inches long, 1 47/64 inches high and 39/64 inch wide. The new READALL instrument is designed for operation over a temperature range of -54°C to +71°C in humidities up to 100% and altitudes up to 70,000 feet. For more information, write for Bulletin 1019.

*Trademark

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

(CONTINUED FROM PAGE 25)

1937 foreign professors, lecturers, and research scholars were on the faculties of 288 American institutions. On the other hand, 1842 faculty members from 367 American colleges and universities were in teaching, research, or consultative assignments in 82 foreign countries. ■

US Science Position Described as 'Poor'

WASHINGTON—Sputnik-inspired soul searching on US scientific position this week produced a highly significant report described as the government's "First Research on Research." It finds at least one important segment of national strength, the Navy, falling seriously short of the mark in basic research. By implication the administration's program is indicted, too.

The report by the independent research firm of Arthur D Little, Inc, and endorsed by the Naval Research Committee, says the Navy should at least double the portion of its R & D effort devoted to basic research.

It warns that the USSR, "the first nation to fully appreciate the importance of science," is catching up with us at "an alarming rate." While we are still ahead or at a par in most sciences except physical chemistry and geophysics, Russia is training scientists 50% faster than the US.

The Secretary of the Navy, W. B. Franke, tabs the report "constructive," but tops it with a reminder that budget considerations come first.

Comparison with industries which share the Navy's high rates of obsolescence is significant. These industries spend an average of 16% of their R & D budgets on basic science; the Navy spends 8%. Some 10 years ago, the Navy was on a par with industry. Industry leaders questioned felt the Navy should be spending 15 to 20%.

The report showed also that sufficient scientific manpower exists to expand the Defense Dept's basic research by 70%. But a severe shortage may develop soon. R & D activities in the US are increasing 10% a year, but the number of scientists and engineers is increasing only 5%. Only 2% of the scientists work on basic research.

Also, budgeting and contracting

(CONTINUED ON PAGE 28)

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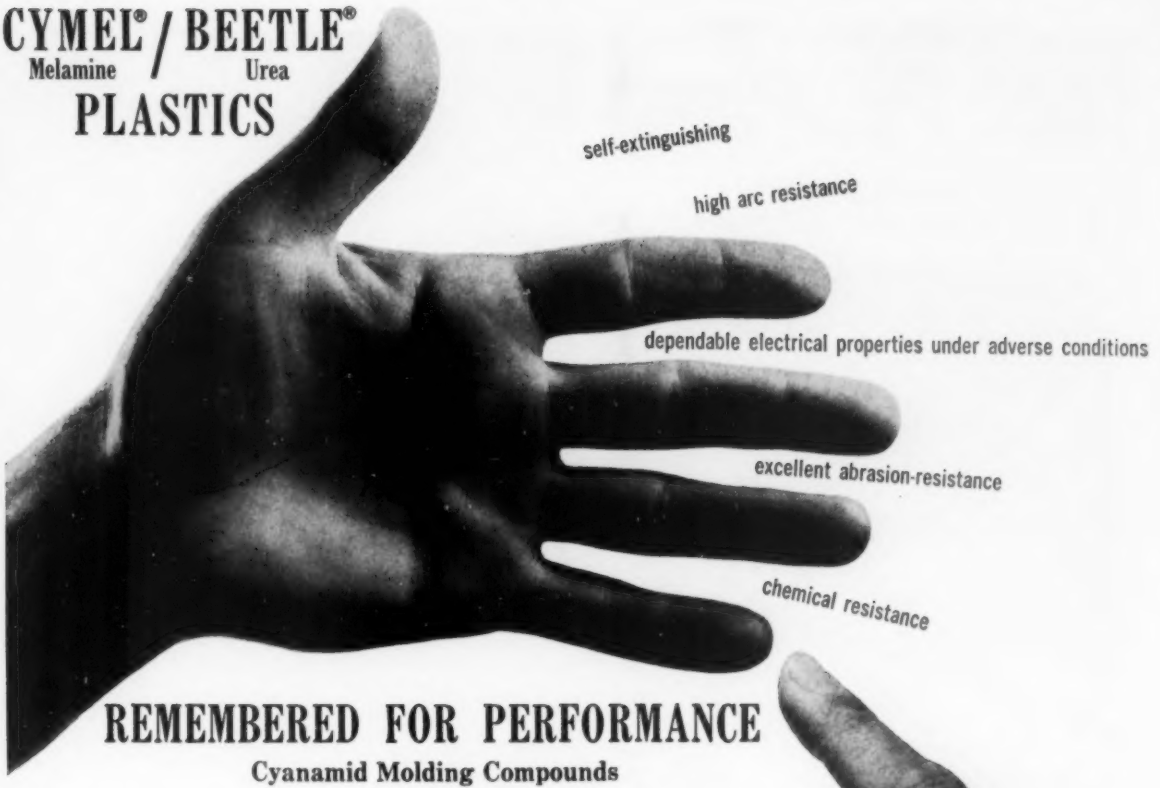
PLASTICS



REMEMBERED FOR PERFORMANCE

Cyanamid Molding Compounds

CYMEL 3135-3136 (glass-filled) Additional distinctive properties: outstanding electrical properties; high impact resistance; extraordinary flame resistance; good dimensional stability. Typical applications: circuit breaker boxes; terminal strips; connectors; coil forms; stand-off insulators. Specifications: Cymel 3135 (MMI-30, MIL-M-14E, Federal L-M-181 Type 8; ASTM D704-55T Type 8); Cymel 3136 (MIL-M-19061, MMI-5).

CYMEL 592 (asbestos-filled) Additional distinctive properties: resistance to atmospheric extremes; high dielectric strength. Typical applications: connector plugs; terminal blocks; a/c, automotive and heavy duty industrial ignition parts. Specifications: MIL-M-14E MME; Federal L-M-181 Type 2; ASTM D704-55T Type 2, SP1 SPEC NO. 27025.

CYMEL 1077 (alpha-cellulose-filled) Additional distinctive properties: Surface hardness, heat resistance, unlimited color range. Typical applications: appliance housings, shaver housings, business machine keys. Specifications: MIL-M-14E – Type CMG (in approved colors); Federal–LM 181 Type 1; ASTM D704-55T Type 1, SP1 SPEC NO. 30026.

CYMEL 1500 (wood flour-filled) – **CYMEL 1502** (alpha cellulose-filled) Additional distinctive properties: Good insert retention. Typical applications: meter blocks; ignition parts; terminal strips. Specifications: Cymel 1500 (MIL-M-14E Type CMG; Federal L-M-181 Type 6; ASTM D704-55T Type 6); Cymel 1502 (MIL-M-14E Type CMG; Federal L-M-181 Type 7; ASTM D704-55T Type 7).

BEETLE® UREA (alpha-filled) Additional distinctive properties: Economy of fabrication; economy of material; myriad translucent and opaque colors. Typical applications: wiring devices; home circuit breakers; tube bases; appliance housings. Specifications: Federal L-P-406A, LC 726-1, ASTM D705-55, Grade 1 (Arc resistance limits are in process of revision by ASTM), SP1 SPEC NO. 27026.

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WRITE FOR COMPLETE TECHNICAL DATA.

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(CONTINUED FROM PAGE 26)

should be on a basis which would allow long range planning without great annual variations.

The committee concludes with a warning that to be "second best" is to risk survival. ■

Gas Injection Applied To Dutch Regulator

AMSTERDAM, NETHERLANDS—A gas regulator for motor vehicles running on propane-butane (LPG) and based on the gas-injection principle, has been designed here. Unlike the conventional LPG apparatus which consists of various parts, the new regulator combines all elements into a simpler, more compact unit.

The injection method insures thorough mixing of fuel and air, resulting in efficiency of performance. Pressure at which the gas is injected is variable, depending on load and speed of the engine. It is adaptable to conventional carburetors since the vehicle can still be operated on gasoline if desired. Engineers foresee its use in just about any passenger car as well as trucks, off-the-road vehicles. ■

British Show Device to 'See' Metal Service

LONDON—The British have developed a new instrument for determining the composition of a metal surface. Known as a scanning microanalyzer, the apparatus has been described by Cambridge Univ as the most important advance since the electron microscope.

The device determines the composition of very small surface areas by irradiating metal surface with a fine focus electron beam—one micron in diameter—and then analyzing the X-ray emissions that result. The microanalyzer was shown for the first time recently at the metallurgical labs of Tube Investment Ltd. where it is being readied for commercial use.

In operation, the electron beam scans an area ½ mm sq. The X-ray emission that results is collected by a counter. This emission modulates the

(CONTINUED ON PAGE 30)

MYLAR® is moisture-resistant . . . has operational temperature range –60° to 150° C

Can the unique combination of properties found in "Mylar" help solve your design problems?

Temperature-humidity resistance assures reliable tape performance. Test provides dramatic proof that magnetic recording tape made with "Mylar" is unaffected by changes in temperature and humidity.

"Mylar"* polyester film is a tough, flexible engineering material. In addition to moisture and temperature resistance (-60° to 150°C.), "Mylar" is unaffected by most chemicals . . . has an average tensile strength of 20,000 psi and a dielectric strength of 4,000 volts per mil for 1 mil film.

On an area basis, tough, thin "Mylar" often *costs less* than heavier, conventional materials. "Mylar" can be embossed, laminated and metalized, punched or coated. The film won't embrittle with age. "Mylar" is available in roll or sheet form . . . in a wide range of gauges.

Find out how the *combination of properties* in "Mylar" can help you solve knotty design problems, improve product performance or cut costs. Write for our booklet containing detailed information on properties and applications. E. I. du Pont de Nemours & Co. (Inc.), Film Dept., Room P-10, Wilmington 98, Del.

*"Mylar" is Du Pont's registered trademark for its brand of polyester film.

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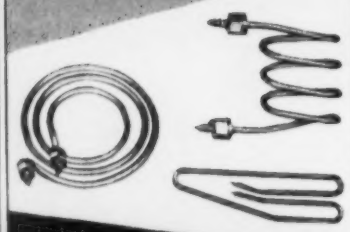
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT MYLAR® POLYESTER FILM

CIRCLE 29 ON READER SERVICE CARD

VULCAN TUBULAR HEATERS



In the best of shapes

Here are just a few of the many shapes to which Vulcan Electric Tubular Heaters are formed. They are ideal for immersion in liquids, soft metals or molten salts. Straight, tubular heaters are easily clamped to metal surfaces or inserted in machined grooves. Vulcan Tubulars are easily cast into aluminum, iron or other metals. They can also be furnished with flattened surface for even more efficient heat transfer.

Vulcan Tubular Heaters are especially useful when you want a lot of heat in a little space. You have a wide choice of sizes — 10″ to 148″ (special — shorter or longer); diameters — .250″, .280″, .333″, .450″; wattage — 10 to 10,000 (or higher); voltage — standard 120 or 240, special 6 to 480 (or higher); sheaths — copper, steel, high temperature alloys.

Solve your hot problems with *Vulcan Versatility* in electric heat. Send coupon for catalog and prices.

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Cartridge • Strip • Tubular • Immersion Electric Heaters
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Please send me catalog and price information on Vulcan Electric Heaters.

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Company.....
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City & State.....

(CONTINUED FROM PAGE 28)

brightness of a beam that scans an oscilloscope screen. Hence X-ray emission and oscilloscope beam are synchronized.

By means of a crystal spectrometer, a single X-ray line can be collected in the counter to determine the emission of this wavelength only. Thus, an image is formed in which brightness at any point is proportional to the amount of emitting element present at corresponding point on the surface of the specimen.

Scanning can be stopped and the probe positioned on any interesting feature. Quantities analysis is then carried out by recording intensity of emission on a pen recorder, and comparing this with an emission specimen from a pure element that has been irradiated at the same beam current. Alternatively, average analyses can be obtained by limited scanning over any desired region. ■

Cornell Scientists Aim for Space Heat Relief

ITHACA, NY—The problems posed by the thermal barrier in space travel may be overcome as a result of a new technique evolved by a team of international scientists at Cornell Univ. They've used an improvised high-temperature up to 1000 k electron diffraction apparatus to prove that the atoms in gaseous molecules at extremely high temperatures are often closer to each other than at low temperatures in the solid state.

Determination of molecular structures of materials at high temperatures is obtained from diffraction patterns produced when a narrow 50,000-volt beam of electrons is scattered by a jet of molecules through which the electron beam is passed.

The pattern of concentric rings of varying spacing and intensity are recorded photographically. Resultant densities, quantitatively related to the scattered electron intensities, are measured with a microphotometer. Extensive computation that must be made is performed by an electronic calculator.

In addition to helping solve space travel problems, the technique is expected to assist in developing many new uses for existing elements and compounds. ■

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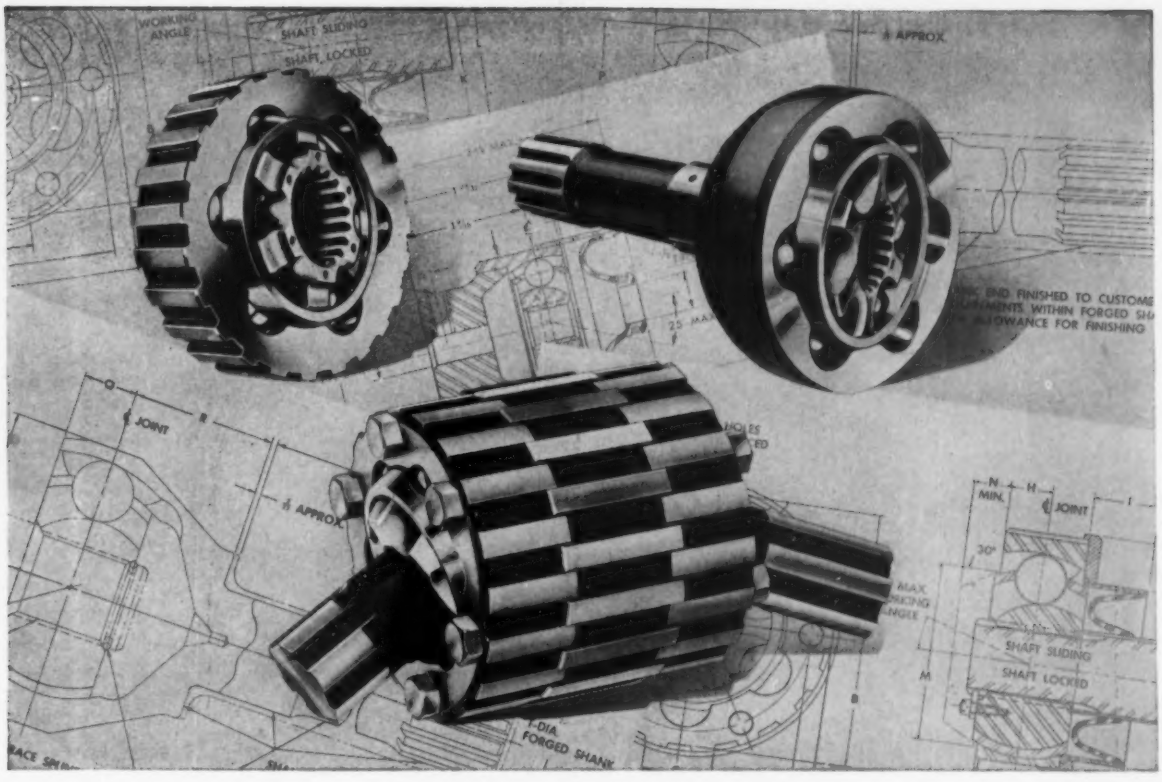

RZEPPA UNIVERSAL JOINTS Now A Product Of DANA

New Con-Vel Division To Produce Famed Constant Velocity Universal Joints—With These Advantages To You:

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Rzeppa universal joints provide perfectly smooth torque all the time, every time, even at angles up to 35°! Rzeppa rules out bounce, chatter, vibration by keeping the hardened steel driving ball bearings in the correct bisecting plane, no matter what the shaft angle may be. The smoother, constant velocity performance of Rzeppa joints naturally increases shaft and bearing life; adds to over-all efficiency and economy of operation.

Rzeppa universal joints are available in a wide variety of sizes, angles, speeds and styles . . . designed for front drives, articulating axles, propeller shafts, and scores of special applications. For information on their many advantages write to—

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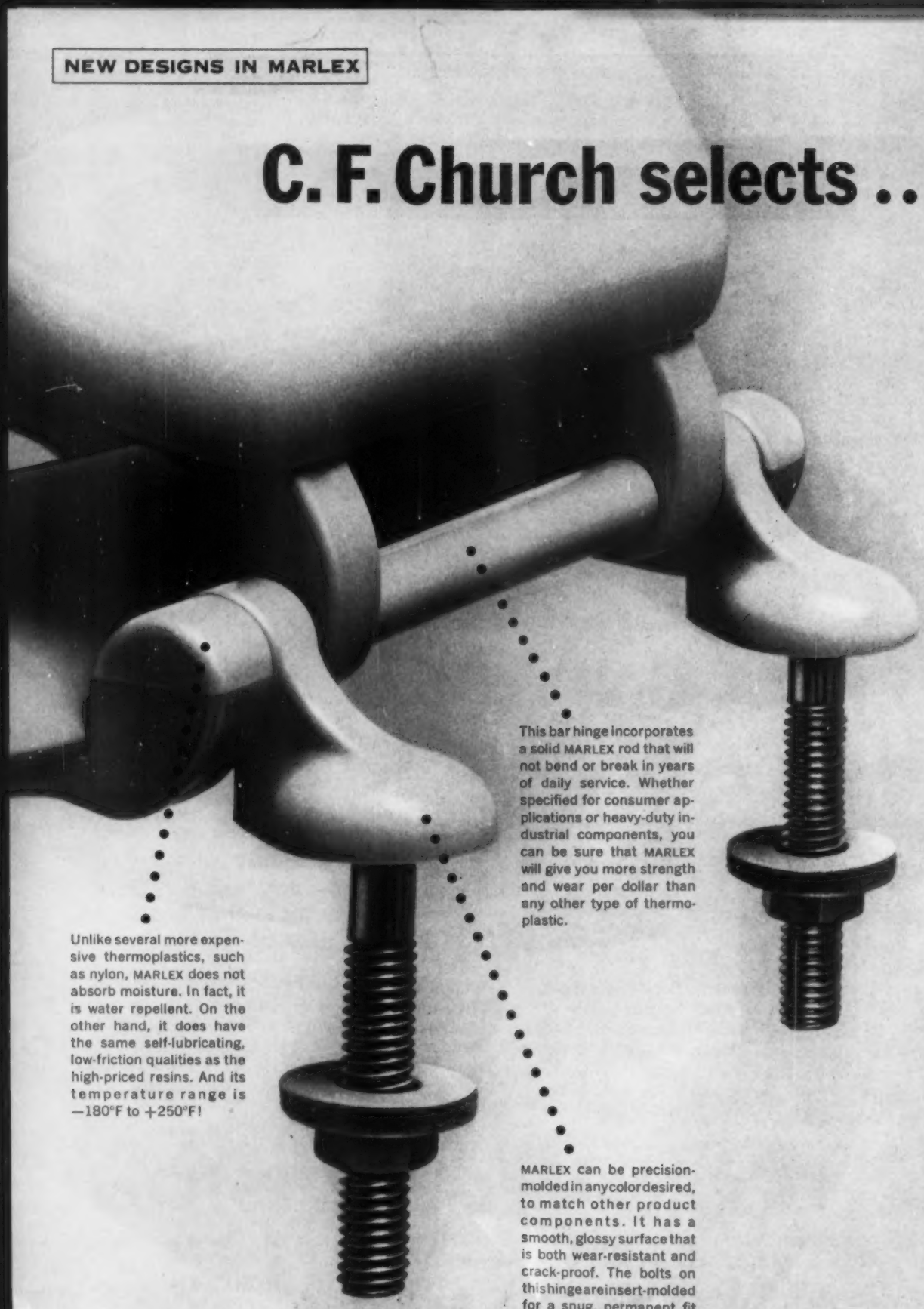
CIRCLE 31 ON READER SERVICE CARD

CIRCLE 32 ON READER SERVICE CARD→

NEW DESIGNS IN MARLEX

C. F. Church selects .....



This bar hinge incorporates a solid MARLEX rod that will not bend or break in years of daily service. Whether specified for consumer applications or heavy-duty industrial components, you can be sure that MARLEX will give you more strength and wear per dollar than any other type of thermoplastic.

Unlike several more expensive thermoplastics, such as nylon, MARLEX does not absorb moisture. In fact, it is water repellent. On the other hand, it does have the same self-lubricating, low-friction qualities as the high-priced resins. And its temperature range is −180°F to +250°F!

MARLEX can be precision-molded in any color desired, to match other product components. It has a smooth, glossy surface that is both wear-resistant and crack-proof. The bolts on this hinge are insert-molded for a snug, permanent fit that is strong and water-tight.

MARLEX

for revolutionary new toilet seat hinge

C. F. Church picked MARLEX rigid polyethylene for this component because it combines economy with all of the qualities needed in a hinge of this type . . . toughness, unbreakability, resistance to corrosion and bacteria . . . self-lubrication, rigidity, hard glossy surface and colorability.

This new MARLEX hinge represents the first major improvement on the conventional brass bar hinge, which has been used by the plumbing industry for almost one hundred years.

Like so many manufacturers, the C. F. Church Division of American Standard recognizes that in MARLEX they have a material that can successfully replace metals, glass and wood, as well as more expensive plastics such as nylon, in thousands of component applications.

No other type of material serves so well and so economically in so many different applications. How can MARLEX serve you?

*MARLEX is a trademark for Phillips family of olefin polymers.

The designer of this new hinge is Sherwood L. Young, Vice President, Product Engineering & Development, at C. F. Church. Mr. Young stated that "after testing several different materials, MARLEX was chosen as it met our required specification for high strength with flexibility, *complete* corrosion resistance and built-in color. It also effected desirable savings in production costs."

MARLEX
Phillips 66
A PHILLIPS 66 PLASTIC

PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma
A subsidiary of Phillips Petroleum Company

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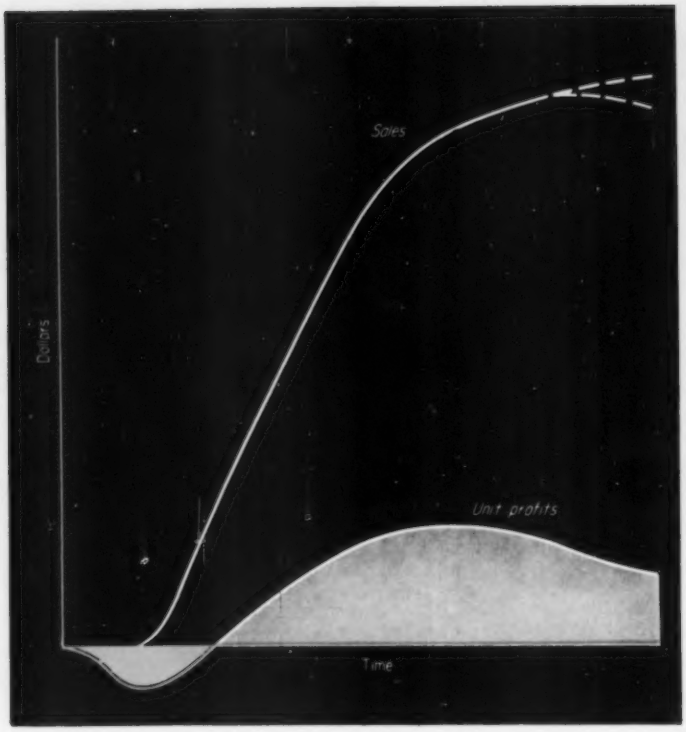
GEneva 4-7600	Digby 4-3480	FRanklin 6-4126	TErrace 4-6600	MUrray 1-6997	EMerson 8-1358	Digby 4-3480



The profit history of a product shows a single peak and two valleys. The first valley is caused by the cost of starting up, the second by price competition or innovation.

THE YARDSTICKS FOR RESEARCH SUCCESS

Here are three indices of new-product profitability used by top management. Why not anticipate their questions with your own analysis of your project?

ARTHUR A LYTLE
Vice-president—research
Union Carbide Metals Co

■ On the last page of this publication we are asked: "Why Don't They Research and Develop. . .?" The same query is raised in every R & D laboratory, in many technical, business and government meetings, in industrial designer's plush offices and in workshop-cellars all over the country.

Perhaps some has! Perhaps a first, crude model is made, patiently coaxed along until, Eureka, it works! With patent granted, the starry-eyed inventor, or R & D group, sits back expecting the millions to roll in.

Nothing happens.

The world goes on, blissfully ignorant of this earth-shaking innovation. The company's new-products committee seems to have pigeon-holed the report. The lone inventor spends a fortune traveling from manufacturer to manufacturer and can't get more than a nod and "very interesting" out of them.

Why? In a nutshell: no profits.

Industry carries on R & D programs for the sole purpose of improving its position—whether this represents profits, prestige, size, or what have you. This motivation rules out support for industrial research that would be "nice to do." It further rules out products already invented but which do not promise an adequate return for the company. Given a demonstrable economic, or other, incentive rest assured the products will be invented and produced by someone.

The key words here are "demonstrable incentive." Normally a company appraises new products or processes in the same way it appraises its mature, standardized products. There are three common methods. The man to convince in your corporation will be using one or more of them.

Return on total sales

This method measures the ratio of average yearly profit to average yearly sales. This ratio gives direct information on the effectiveness of the sales and production efforts. However, from the standpoint of business management, it has the very serious fault of ignoring the factor of original investment in sales and production.

A PRODUCT'S FUTURE

ORIGINAL INVESTMENT: $1,000,000

		Sales	Cost	Profit
	1	0	$90,000	−$90,000
End	2	$500,000	300,000	200,000
of	3	1,000,000	600,000	400,000
Year	4	1,100,000	650,000	450,000
	5	400,000	200,000	200,000
Totals		$3,000,000		$1,160,000
Average		$600,000		$232,000

SALVAGE OF ORIGINAL INVESTMENT: $400,000 after 5 years

A — Return on sales = $\frac{\text{Average Yearly Profit}}{\text{Average Yearly Sales}} = \frac{232,000}{600,000} = 38.7\%$

B — Return on Investment = $\frac{\text{Average Yearly Profit}}{\text{Original Investment}} = \frac{232,000}{1,000,000} = 23.2\%$

C — Present Worth of Cash Flow @ 10% Interest:

$ −81,700	
165,000	
300,000	Profits and losses
308,000	
124,000	
248,000	Salvage value
$1,063,300	

D — Ratio of Present Worth to Original Investment = $\frac{1,063,000}{1,000,000} = 1.063$

E — Actual Interest Rate Earned = 11.8%

Return on investment

Two products which offer the same potential total sales and profit may differ appreciably in equipment-to-produce, buildings, cash, or inventory required. A company would, of course, greatly prefer the lower-capital-cost product. The return on investment criterion is, therefore, widely used to relate profit before taxes to the total investment.

Cash Flow

But accounting, like all other activities of modern business, has become progressively more sophisticated. Newer concepts attempt to introduce the rate of flow of money in and through the company and the time value of money.

These methods integrate the complete picture of all costs including R & D; inventory, operations, sales costs, sales income, return on investment, and the value of dollars spent in the future in terms of their value at the start of a project.

The cash-flow method requires a running record of income and outgo on a project as far into the future as possible and so, once accepted, it becomes a guide for the execution of the project as well as a means of evaluation at the start.

A typical operating cash-flow curve is shown on the previous page. In the early stages, before sales begin, the cash flow is negative, representing expense. As sales increase, the original costs are paid off and profits mount.

The cash flow for each year in the future is then transformed by compound interest formuas (see box on the next page) into equivalent dollars today so that direct comparison of products can be made.

Let's work out an analysis of a product, using all of these methods.

A sample product (see above)

You will be given, or can estimate yourself, the original investment in design, development, plant, equipment, publicity, operating capital, to get the product into production. This product will cost $1,000,000 to get started and $90,000 during the first year before any sales are made.

In succeeding years, sales mount and profits roll in nicely until the fifth year when the market saturates or a competing product can be expected to cut into the market.

At the end of the fifth year, plant and equipment are worth (or could be sold for) $400,000. You figure to take your profits and look for a new investment at this time.

Return on sales is, simply, average yearly profit over average sales. Watch for the $90,000 cost during the first year which shows up as negative sales and must be subtracted from profits.

Return on investment is a similar ratio based on the original investment.

Neither of these calculations include the time value

COMPOUND INTEREST—A PRIMER

We all studied it in school. Our economics professors made impressive noises about the "time value of money," and if you were lucky enough to penetrate the fog of big words, you discovered this simple set of ideas.

Take $100 and hide it in your mattress. A year from now you'll find $100 there.

Take $100 and put it in a savings bank. A year from now you'll find $103, maybe more.

Presumably the bank loaned your hard-earned money to a businessman who used it to build a new plant or buy a new machine. He paid the bank $6 or $8 for the privilege. The bank took a rake-off and paid you $3.

Your increment (or interest rate) was 3% per year. If you leave the $103 with the bank for another year, your $100 will be worth $106.09.

Alternatively, you're saving for a new car. You will want to make deposits at regular intervals rather than as a lump sum. Suppose you deposit $500 at the end of each year for five years. The first $500 accumulates interest for four years; the second for three years; the third for two, and so on. With interest the total will be more than $2500, but less than $2500 compounded at 3% for the full five years ($2,898.25). It actually comes to $2,654.55.

All of these computations are based on just five variables:

i — interest rate for a given period (usually one year)
n — number of interest periods (years)
P — Principal sum at a time regarded as present (present worth)
S — Sum n periods later
R — One of a series of equal payments made at the end of each interest period.

They are related by three equations:

$$S = P(1+i)^n$$

$$S = R\,\frac{(1+i)^n - 1}{i}$$

$$P = R\,\frac{(1+i)^n - 1}{i(1+i)^n}$$

The computations are a bit awkward, particularly with the accuracy needed by bankers, and so interest tables have been computed for these factors (and their reciprocals) for practically all interest rates (i) and numbers of years (n). An abbreviated set is given at right.

The essential point in all this is that a sum of money on hand today (P) has its equivalent in a series of equal payments (R) or a larger sum at some time in the future (S). This equivalence of P, S, and R is what you are using when calculating the cost and profit of new products. —RMK

Given S, To Find P

$$\frac{1}{(1+i)^n}$$

n	Interest Rate i						
	6%	8%	10%	12%	15%	20%	25%
1	0.9434	0.9259	0.9091	0.8929	0.8696	0.8333	0.8000
2	0.8900	0.8573	0.8264	0.7972	0.7561	0.6944	0.6400
3	0.8396	0.7938	0.7513	0.7118	0.6575	0.5787	0.5120
4	0.7921	0.7350	0.6830	0.6355	0.5718	0.4823	0.4096
5	0.7473	0.6806	0.6209	0.5674	0.4972	0.4019	0.3277
6	0.7050	0.6302	0.5645	0.5066	0.4323	0.3349	0.2621
7	0.6651	0.5835	0.5132	0.4523	0.3759	0.2791	0.2097
8	0.6274	0.5403	0.4665	0.4039	0.3269	0.2326	0.1678
9	0.5919	0.5002	0.4241	0.3606	0.2843	0.1938	0.1342
10	0.5584	0.4632	0.3855	0.3220	0.2472	0.1615	0.1074
11	0.5268	0.4289	0.3505	0.2875	0.2149	0.1346	0.0859
12	0.4970	0.3971	0.3186	0.2567	0.1869	0.1122	0.0687
13	0.4688	0.3677	0.2897	0.2292	0.1625	0.0935	0.0550
14	0.4423	0.3405	0.2633	0.2046	0.1413	0.0779	0.0440
15	0.4173	0.3152	0.2394	0.1827	0.1229	0.0649	0.0352
16	0.3936	0.2919	0.2176	0.1631	0.1069	0.0541	0.0281
17	0.3714	0.2703	0.1978	0.1456	0.0929	0.0451	0.0225
18	0.3503	0.2502	0.1799	0.1301	0.0808	0.0376	0.0180
19	0.3305	0.2317	0.1635	0.1161	0.0703	0.0313	0.0144
20	0.3118	0.2145	0.1486	0.1037	0.0611	0.0261	0.0115

Given P, To Find R

$$\frac{i(1+i)^n}{(1+i)^n - 1}$$

n	Interest Rate i						
	6%	8%	10%	12%	15%	20%	25%
1	1.06000	1.08000	1.10000	1.12000	1.15000	1.20000	1.25000
2	0.54544	0.56077	0.57619	0.59170	0.61512	0.65455	0.69444
3	0.37411	0.38803	0.40211	0.41635	0.43798	0.47473	0.51230
4	0.28859	0.30192	0.31547	0.32923	0.35027	0.38629	0.42344
5	0.23740	0.25046	0.26380	0.27741	0.29832	0.33438	0.37184
6	0.20336	0.21632	0.22961	0.24323	0.26424	0.30071	0.33882
7	0.17914	0.19207	0.20541	0.21912	0.24036	0.27742	0.31634
8	0.16104	0.17401	0.18744	0.20130	0.22285	0.26061	0.30040
9	0.14702	0.16008	0.17364	0.18768	0.20957	0.24808	0.28876
10	0.13587	0.14903	0.16275	0.17698	0.19925	0.23852	0.28007
11	0.12679	0.14008	0.15396	0.16842	0.19107	0.23110	0.27349
12	0.11928	0.13270	0.14676	0.16144	0.18448	0.22526	0.26845
13	0.11296	0.12652	0.14078	0.15568	0.17911	0.22062	0.26454
14	0.10758	0.12130	0.13575	0.15087	0.17469	0.21689	0.26150
15	0.10296	0.11683	0.13147	0.14682	0.17102	0.21388	0.25912
16	0.09895	0.11298	0.12782	0.14339	0.16795	0.21144	0.25724
17	0.09544	0.10963	0.12466	0.14046	0.16537	0.20944	0.25576
18	0.09236	0.10670	0.12193	0.13794	0.16319	0.20781	0.25459
19	0.08962	0.10413	0.11955	0.13576	0.16134	0.20646	0.25366
20	0.08718	0.10185	0.11746	0.13383	0.15976	0.20536	0.25292

of money. Further, we have not shown the effects of depreciation or income taxes, both of which would cut deeply into the profit percentages. Neither ratio includes the salvage value—an important factor in gaging the production effectiveness of your invested dollar.

The cash-flow calculation starts with an assumed interest rate. You insist on a 10% return on your investment, for example. Then all cash flows following the initial investment are transformed into their equivalent present worth. Each must be reflected back one or more years so that they may be summed as a total equivalent profit or loss in terms of cash on hand today.

Note that this sum exceeds the $1,000,000 initial investment. This means your initial investment will be returned to you over the five-year period and simultaneously earn the required 10% interest rate plus $63,300 more. The product passes this test easily.

The present-worth ratio is a measure of how well the product passes the test of desired interest earnings.

The actual interest rate earned is a trial-and-error calculation in which you assume a new interest rate and recalculate the present worth of the cash flows while attempting, by correct choice of interest rate, to make

net cash flow exactly equal to the original investment. In this case the rate of 11.8% tells the investor exactly what his return will be and permits him to decide whether this is where he wants to put his money rather than in a bank (at 3½%), or bonds (5%), or speculative stocks.

Comparisons made among any of these systems can be of real value in directing R & D projects along potentially important lines and giving them some relative order of merit. Of course, much extrapolation is needed for this type of study and so application to projects or ideas in research may be highly speculative, depending on how advanced the project.

It has been our practice to be very liberal in our anticipated expenses. Inventories, construction and production costs, development and promotion charges are set high, and income items are set low. Thus, if a project shows up favorably, most of the risks have already been anticipated, and you would be fairly sure of success in the next development step. Obviously any appraisal system must be reviewed critically at intervals to take into account changes in technology, market, basic construction costs, and perhaps the entry of competitive products in the field.

What about failure?

Any discussion of success in research must inevitably give some consideration to the possibility of failure. Every idea, invention, or project does not automatically result in successful research. How to spot the poor risks and stop them without discouraging creative talents is one of the important responsibilities of research management.

Dedicated researchers are better salesmen than they know and management is seldom in a technical posititon to refute their arguments. Therefore, unless the product is definitely of no interest, the research should be supported, at least through its first phase. At the end of the first phase, adequate data will be available to judge the potential of a product and no one—including the researcher—can complain if the project is stopped then for good reason. ■

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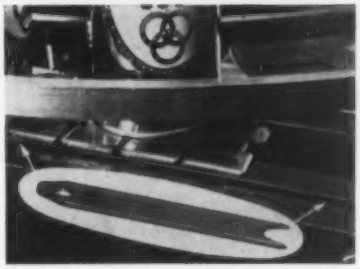
Gives the property advantages of nylon, PLUS . . . improved mechanical characteristics:

- Greater Rigidity—higher modulus of elasticity, less deformation under load.
- Higher Heat Distortion Temperatures—distortion temperatures 70% higher than nylon 101.
- Lower Thermal Expansion—coefficient approximately 60% of nylon 101.
- Low Surface Friction—can be used without lubrication.
- High Wear and Abrasion Resistance—can outlast, outperform metal.



NYLATRON GS wear strips provide excellent wear cushion between metal bottling chain and conveyor stands. Due to inherent wear resistance and low surface friction, NYLATRON outwears metal strip while reducing wear on chain and stand.

NYLATRON GS, a molybdenum disulphide filled nylon*, is formulated to expand the field for nylon parts such as bearings, bushings, liners or other wear parts. Its superior mechanical and thermal characteristics coupled with the chemical and electrical properties of nylon result in a material with proven advantages. It is produced under controlled manufacturing standards to assure the ultimate in uniformity, quality and reliability.

Stock shapes of NYLATRON GS include rod, strip, tubing, tubular bar and plate in all standard sizes—for rapid, low-cost fabrication on standard metalworking tools. In addition, it is available in powder form for molding.

Polymer can also supply stock shapes of all commercial nylons on request.

Write today for detailed information about NYLATRON GS—or other nylon formulations to meet your specific requirements.

*Patents applied for

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POLYPENCO

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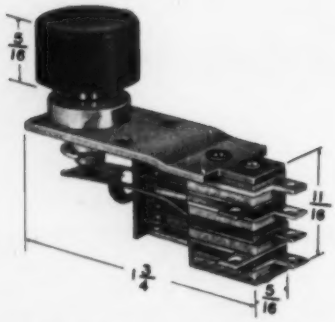
Does your product design specify an open blade switch in multi-pole variations . . . in a minimum of space?

Acro's open blade switches as small as 15/64" x 9/16" x 13/16" adapt to an infinite number of precision snap action applications

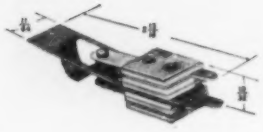


PUSH BUTTON (216-0030-00)

Small, compact, double pole, double throw switch, push button actuation. Designed for panel mounting — carries a 10 amp load.

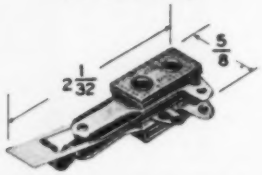
• Yes . . . high adaptability is a feature you'll like in Acro switches. Choose your own housing and any number of components . . . when you specify Acro's open blade switches. You'll get absolute minimum size with high electrical rating in an infinite variety of combinations. Versatile Acro open blade switches can be stacked and can also be adapted to set or return operations. The high adaptability of Acro's open blade switches will solve more of your product design problems.

LARGE ECONOSNAP (E-A1POBD-R)



Carries 25 amp load! Compact, low cost. Multi-pole construction available, as well as screw construction. Can be provided with roller or nylon button for main blade.

SMALL ECONOSNAP (E-S1POBD-R)

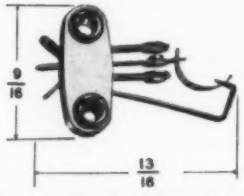


Available in return and set types, can be made with screw construction. A roller or nylon button can be added to main blade if desired. Multi-pole versions also available. Ratings: UL inspected — 15 amps, 125 volts AC — 7.5 amps, 250 volts AC — ½ H.P., 125-250 volts AC.

MIDGET ECONOSNAP (ME-S1POBD-R)

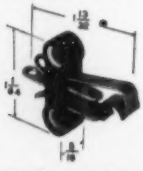
A compact, low cost, single pole, double throw switch. Long life assured, carries a 10 amp load. Has beryllium copper and stainless steel spring members and fine silver contacts. Roller or nylon button can be added to main blade. Multi-pole versions available. Choose from set or return type action. Rating 10 Amps, 125 Volts AC.

MODEL M-OM (M-2MOBD-RB)



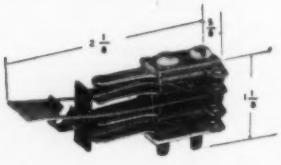
Here's a real sub-miniature switch — extremely small in size, with an unusual configuration that makes it a real space-saver. Carries a 3 amp load at 125 VAC. Can also be ganged for multipole circuitry.

MODEL M-OB (1MOBD-R)



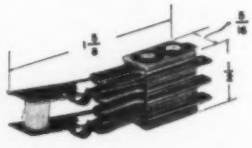
Very small size, requires minimum space, yet carries 12 amp load. Multi-pole construction available. Main blade provided with insulated extension if required. Designed for long electrical and mechanical life. Rating: UL inspected 12 amps, 125 volts AC-6 amps, 250 volts AC.

SMALL MULTI-POLE (S2-POBD-R)



Has beryllium copper and stainless steel spring members and silver contacts. Provided with side solder terminals. The laminations are held in assembly by two 6-32" screws. Carries a 15 amp load, 125 volts A.C.

MIDGET MULTI-POLE ECONOSNAP (ME-S2POBD-R)



Ideal for economical and positive control of two circuits. Choice of return or set type. Rear terminals. Laminations are secured by two eyelets which provide holes for mounting screws. Carries a 10 amp load, 125 volts AC.

• Take advantage of Acro's free engineering service. Whatever your switching problem, Acro will put its engineers to work on it. Just tell us what you want a switch to do, where it has to fit and how. No obligation of course.

Manufacturers of a complete line of load-tested precision snap action switches and relays.

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"OUR 20th YEAR"

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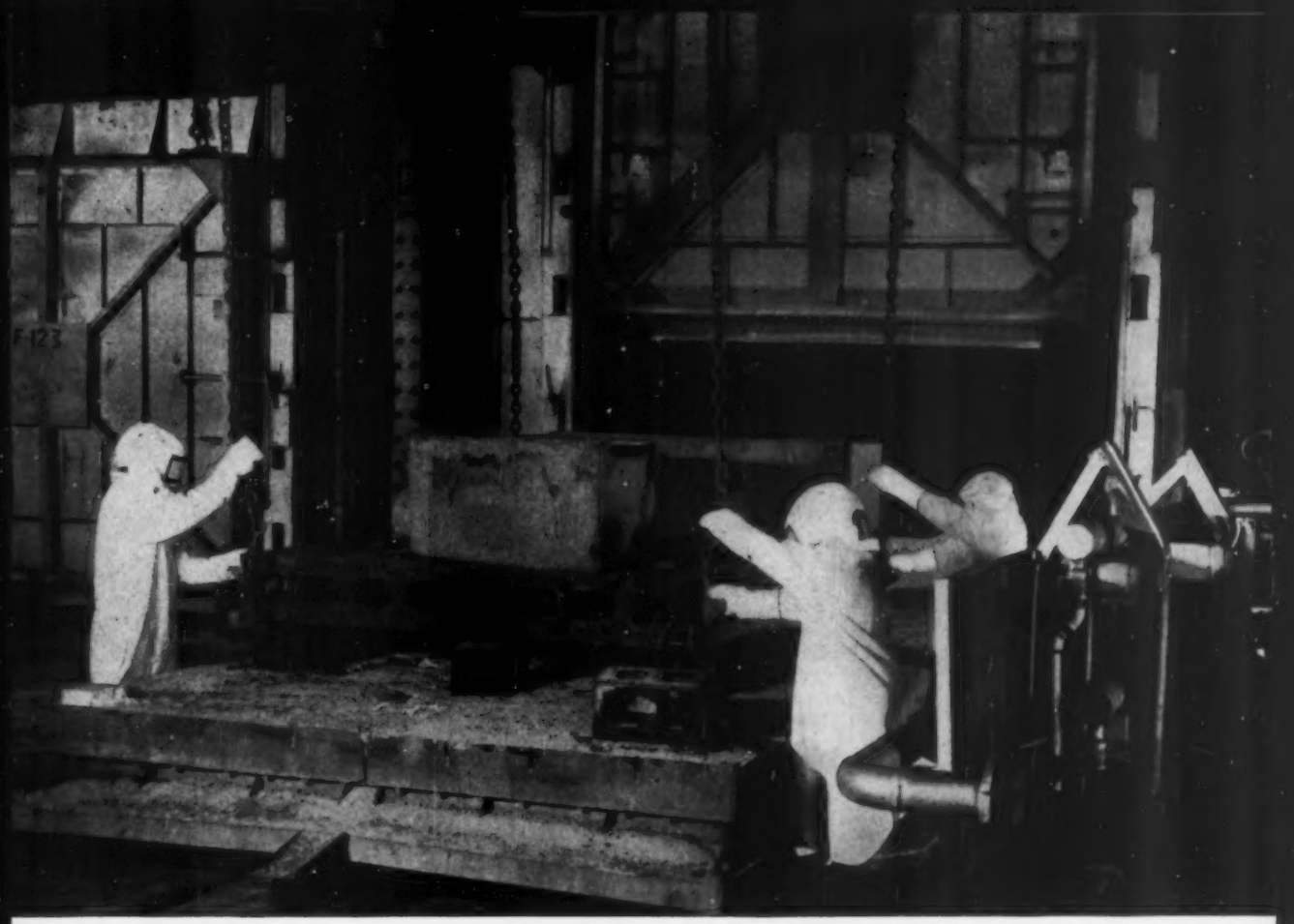


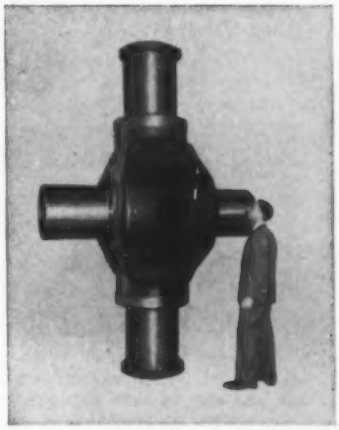
Blaw-Knox Steel Foundries have the heat treating capacity to handle the largest casting

Your steel casting gets precisely the characteristics of uniform hardness, toughness, or temper you specify in a Blaw-Knox Steel Foundry. Blaw-Knox Steel Foundries are equipped with huge pit-type furnaces—some as large as 42 feet × 20 feet × 13 feet deep, and banks of car type furnaces to accommodate the largest steel casting or batches of smaller ones.

Quench tanks as large as 21 feet × 12 feet and 8 feet deep are available, and all Blaw-Knox Steel Foundries are equipped for spray quenching in which specific areas of steel castings are given special quenching. Further flame hardening or other hardening procedures are provided to meet your exact requirements.

Complete heat treating, quenching, and hardening is another way in which Blaw-Knox Steel Casting Service adds value to your product. Blaw-Knox, as one of the world's leading rolling mill and industrial machinery builders, keeps a sharp eye on the end-use requirements of a casting from start to finish. It's your assurance of a component of the highest quality, made for maximum service.

If you design or build products using cast steel components, ranging from 50 pounds to 300,000 pounds, Blaw-Knox would like you to have a copy of our brochure detailing Blaw-Knox Steel Castings Service. Write to the Foundry and Mill Machinery Division, 300 Sixth Avenue, Pittsburgh 22, Pennsylvania. No obligation of course.

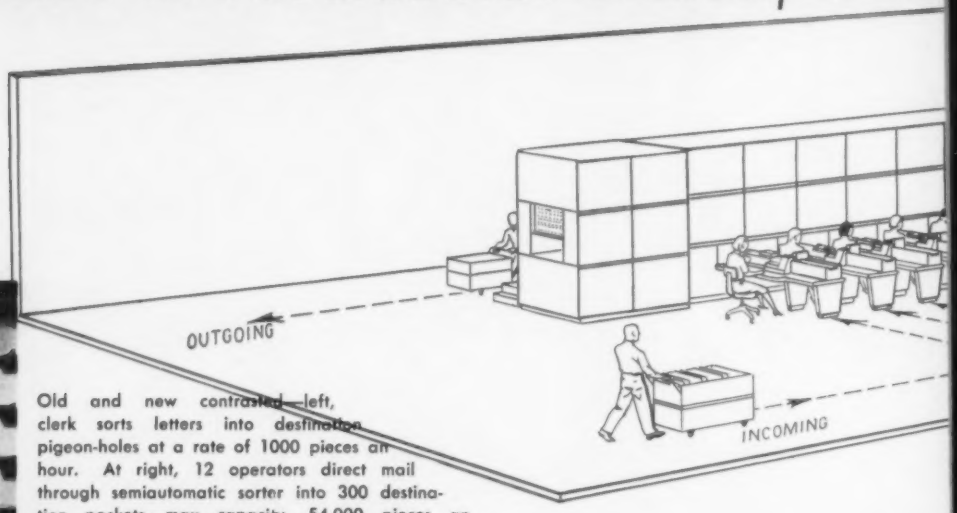


This main axle casting for the 60-cubic yard Mountaineer Shovel was cast in a Blaw-Knox Steel Foundry. Wt.—18,000 lbs.

BLAW-KNOX **STEEL CASTING SERVICE**

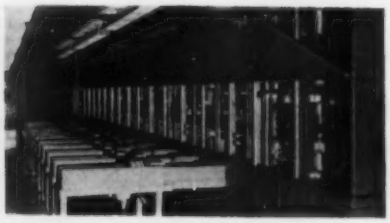
CIRCLE 39 ON READER SERVICE CARD

TRENDS IN APPEARANCE DESIGN/*semi-*



Old and new contrasted—left, clerk sorts letters into destination pigeon-holes at a rate of 1000 pieces an hour. At right, 12 operators direct mail through semiautomatic sorter into 300 destination pockets—max capacity, 54,000 pieces an hour; anticipated production, 36,000 an hour. Each operator has own console, jutting out 7 ft from conveyor block that's 78 x 10 x 5 ft wide.

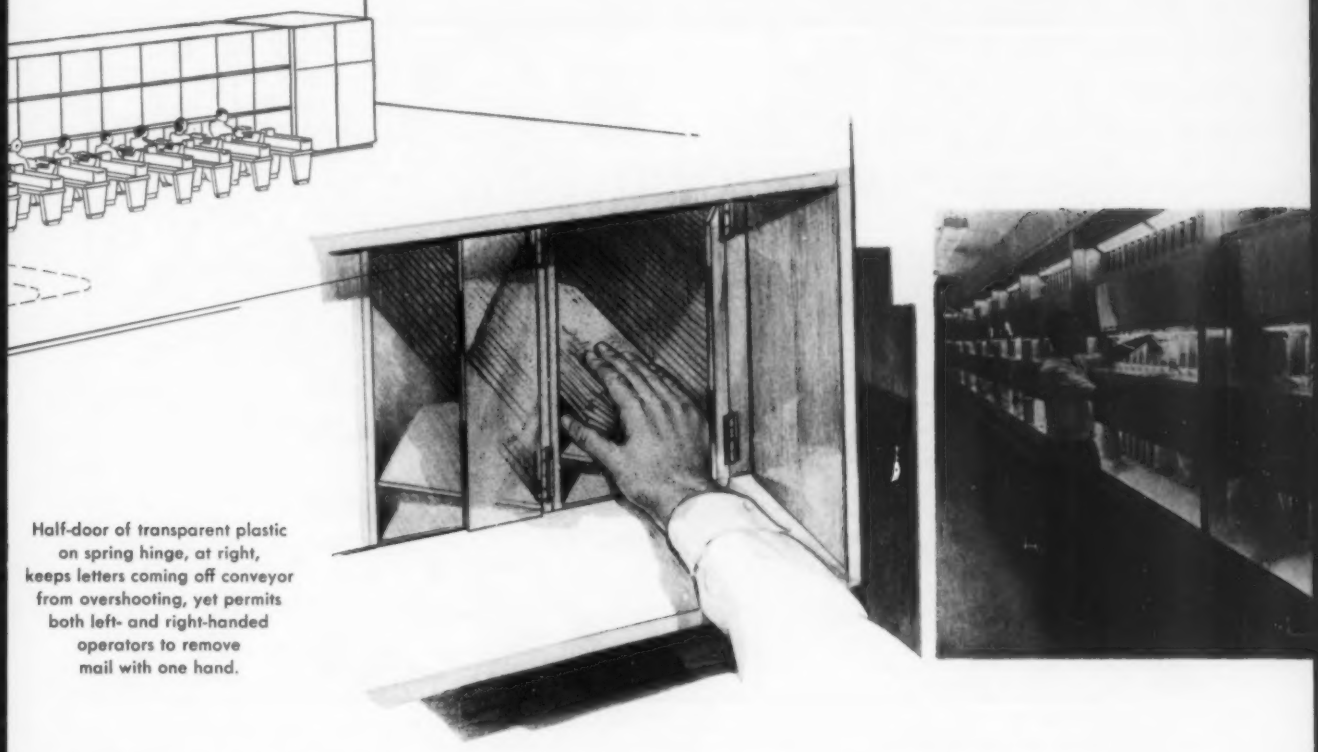
Supervisor's control center is located at end of sorter behind operator modules.



18 doors make up front of sorter, weigh 30 lb each, yet lift virtually at fingertip pressure and stay up until pulled down again. Operators do not even have to move aside. Doors operate in aluminum tracks, which also serve as panel separator strips. Top strip houses top hinge; strip along bottom also serves as door-rest. Latch is in center hinge above eye level. Made of vinyl-clad steel bonded to plywood.

Console height and keyboard spans were selected on the basis of human engineering data. Console, above, is indented in back of each operator's chair and also at loading end to provide maximum space and avoid hemmed in feeling. A piano-type key was selected as most restful in continuous operation and provides greater freedom in point of finger contact. Keys were recessed and slightly hollowed to minimize wander.

automatic letter sorter



Half-door of transparent plastic on spring hinge, at right, keeps letters coming off conveyor from overshooting, yet permits both left- and right-handed operators to remove mail with one hand.

■ When he stands before the traditional wooden frame and its 49 pigeonholes, Uncle Sam's average mail clerk can sort about 1000 letters an hour. But seat him at a console of the US Post Office's new letter-sorting machine and the same worker can process three times as many.

This machine, one of the first big steps in the Post Office's program of mechanizing and applying automatic control to its job of handling mail, is based on mechanical principles developed by Rabinow Engineering Co. The first of an order of 10 sorters engineered and produced by Burroughs Corp has been installed in Detroit's Roosevelt Park unit.

Even though the sorter was developed and is being produced for only one customer—and on a competitive-bid basis at that—Burroughs made the industrial design services of Lawrence H. Wilson Associates, Detroit, an integral part of its contract bid. The reasons for this are inherent in the original concept of the machine. It was to form a new and all-encompassing environment for workers who previously have been unused to industrial production methods and equipment. This new environment had to be comfortable and pleasant, and conducive to operator efficiency and accuracy.

Twelve operators (or less—initial order is for nine-module sorters) sit at consoles centered around 10-key control panels. The letters, hand-loaded into the console at the operator's right, pass before the operator on a conveyor. Numerical combinations are tapped out which route each piece of mail to one of 279 destinations. The letter, which remains unmarked except for the operator's identifying number, drops into a tray, in which it circles the full length of the sorter cabinet and is finally deposited in a destination pocket in the rear of the sorter. When an address is illegible or an error is made, the operator can route the letter to a reject pocket by depressing all 10 keys at once.

Although the back of the machine is open, the Post Office also required access to the front of the sorter as well. That is why the long front panel is actually a series of doors, which fold up vertically, jackknife fashion, to above standing height. Lifting any one of the doors automatically cuts off all power to the sorter.

The sorter is the result of an accelerated design program. From contract signing to completion of the production model took seven months. Basic industrial-design contributions were finished in four months.

Burroughs' Appearance Design Dept built most of the full-scale mockups and served as liaison between the Wilson organization and Burroughs engineering. Industrial-design personnel sat in on engineering conferences. Frequently, engineering changes affecting appearance were approved by industrial-design group chiefs while drawings were still on the board.

Work began with visits to the test installations of Dutch and Belgian sorters in the Washington, DC area. These were studied for size, mechanisms, operators' reactions, control board arrangements, and the general problems of handling large volumes of mail by machine.

Based on dimensional drawings by the Wilson staff, mockups were made to scale of destination pockets, console and keyboard. These were used to determine dimensions, work angles and positions, textures, colors and materials for optimum operator efficiency and comfort. This was in line with the engineers' and designers' joint decision to make the operator the focal point of the new sorter. It was the sorter's great size—as long and as high as two average ranch houses—that dictated the architectural approach selected by Lawrence H. Wilson Associates as basis of their work. That is why the sorter's cabinetry is one unbroken wall accented only by the aluminum panel separator strips. This architectural note was further strengthened when it became necessary to advance the panels housing the conveyor turn-around module 6 in., to give the engineers more room for their machinery. ■

Kodak reports on:

how modern scientific research is organized . . . an occasional dunk for the new oscillography . . . new life for the old telescope or copying camera

The hot oil project

That, roughly, is how these things develop. The principal constituents of *Eastman Lube 3A* are straight-chain fatty acid esters of trimethylpentanediol, a compound obtained by a certain setting of the valves at our "oxo process" plant in Longview, Texas. No other of the 16 currently accepted 350°F lubricants does so well in the crucial lead corrosion test as *Eastman Lube 3A*, which doesn't even require a special additive to keep it from attacking lead after six months. On the other crucial tests demanded by MIL-L-7808C, *Eastman Lube 3A* makes out OK. Those who need further facts to be impressed can write Eastman Chemical Products, Inc., Kingsport, Tenn. (Subsidiary of Eastman Kodak Company), where friendships formed at a comparatively cool 350°F are expected to warm with the hot pursuit of lubricity to higher temperatures but never in themselves to prove lubricous.

To permanize the unusual

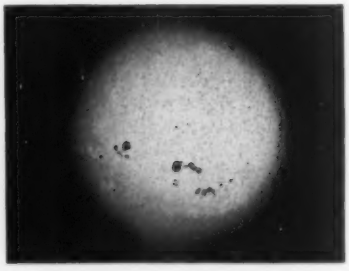
Three good instrument manufacturers have been pushing for all they are worth a type of oscillograph that puts out a visible record instantly without chemical processing. Maybe you have one or a bank of them. They're terrific. They use *Kodak Linagraph Direct Print Paper*.

Occasionally—maybe often—you get a record that you wish had the long life that chemical processing gives. Now you can have your cake and eat it.

To offset such an old saw (an infelicitous one, moreover, to employ in discussing a prepared powder which so readily dissolves in a gallon of hot water), we have gone to the trouble of manufacturing a new word, "Permanize," as in *Kodak Linagraph Permanizing Developer*. Dunk as directed, fix, wash, and dry. No darkroom needed.

If your usual source of Kodak Linagraph Papers *cannot supply it, drop a sharp note of reproof to Eastman Kodak Company, Photo Recording Methods Division, Rochester 4, N. Y.*

De orbe . . . de urbe



This picture of the solar disk with sunspots and bright faculae was taken on *Kodak Autopositive PB Film* at the prime focus of a 6-inch *f*/15 reflecting telescope at 1/100 second without a filter or any interposed optics. The ¼" negative image can stand a lot more enlargement. Alas, there is no room for that here, or for an explanation of why this particular film was chosen. To read all about it, send for a preprint of "Photographing the Sun" to Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y. If you've made a reflecting telescope and sometimes wonder why, you may find a soul-satisfying answer in that article.

The space here must serve more pressing needs having to do with another product called "Autopositive," the new *Kodagraph Autopositive Projection Paper*. This paper you put in an enlarger or copying camera and use for reproducing drawings or documents at any desired magnification or minification. Black photographs black, and white photographs white. The negative-to-positive jazz is avoided, and even the conventional hypo fixing bath is replaced by a jet of plain water. For information on where to buy it and how to use it, write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y.

Kodak

8 *steps to better engineering writing...*

1. . VANITY AND LAZINESS, BE SIMPLE
2. . BE POSITIVE, BE BRAVE
3. . BE PERSONAL, BE SPECIFIC
4. . BE CONCISE, DON'T OVERSTATE
5. . VOCABULARY, GRAMMAR, PUNCTUATION
6. . TABLES, FIGURES, CAPTIONS
7. . WHERE TO PUT WHAT
8. . SIT DOWN AND WRITE

RICHARD M. KOFF, *senior associate editor*

Lesson . . 7

Who reads engineering reports and letters? Our guess would be:

65% are industrial executives,
15% are engineering colleagues,
15% are students or assistants,
5% are public relations people and the general public.

What is your purpose in writing? A letter may suggest a project and express your interest in doing the R & D. A progress report may show encouraging results but show that costs are over the budget. An article may outline a new design technique developed under your supervision.

In each case your overt purpose is to inform; your ulterior purpose is to influence. You can do neither without the conscious or unconscious cooperation of the reader.

WHERE TO PUT WHAT

Your reader is busy, harried—and lazy. To get his attention, see the suggestions in Lesson 6 about making reports and letters more attractive looking. **To save him from work, predigest the information; put the conclusions up front.**

This is the single most difficult thing to teach engineers. All our training is of the object-procedure-results-conclusions school. We approach the writing task as if it were a problem in geometry: Given . . .

Most of your readers know better than you do what has been "given."

When the doctor returns from the operating room, you ask, "How's my wife? How's the baby? When can I see them?" Sex, weight, time, and blood pressure can wait. Similarly the chief engineer, the research director, the president, want your recommendations first. The why's and wherefore's can come later.

Here's one approach to the technical report based on these principles:

Title page. Make your title short and use an active verb rather than a label. "The proposed 10-gpm pump" becomes, "Will a 10-gpm pump pay its way?"

If necessary, a paragraph of two or three short sentences may amplify the title, but make sure they generate interest rather than destroy it.

> "The 5-gpm model is losing sales, but development and tooling costs of a 10-gpm pump will be high. Here are Engineering and Production cost estimates plus a Sales forecast. Net profit should be $20,000 in five years."

The reader *could* stop here, and that's a sign of good report writing, but he's more likely to go on.

Add your name, the date and what other information necessary for the record.

This is enough for the first page of a more-than-10-page report. Shorter reports can combine title with abstract.

Abstract. A much-too-formal word for the most important part of your report. This page (never more than one) has a synopsis of the problem, conclusions (if any), and recommendations. You can give reasons (without proof), tabulate values (without derivations) even photograph a final model (a recommendation in picture form). The combination of title and abstract on one page makes an ideal "short" report.

Contents page. This is really the index. Its primary purpose is for finding specific information. Its secondary purpose: to show the structure of a report, the plan of treatment.

Introduction. Set the stage. Why was the report written? Where did your information come from? How has it been presented?

Body. Here you prove what you said up front. List the "given" and its derivations. The order of presented material should be logical rather than chronological. Make use of subheadings, underlining, capital letters to divide your information into chewable "bites." Leave detail proof for the appendix. Headings must show the structure of the report—they'll be repeated on the contents page.

Conclusions. Recapitulate the reasoning with references to the page where each point is proved.

Appendix. Includes charts, graphs, tabled data, and tangential studies whose conclusions were used in the body of the report.

Bibliography. This may be limited to other reports or it may include technical books, handbooks and the like.

There's nothing sacred in this arrangement. Its greatest value lies in the emphasis placed on the reader—his wandering attention and peculiar interests. Don't be bound by convention or college training. Most likely the ideas that appeal to you will appeal to others. Note carefully the reports you read and admire. What makes them readable? Can you apply the same techniques in your own?

***Reprints** of this series will be available at the end of October. To reserve your copy, Circle P15 on the Readers Service Card.*

POINTS OF

THE QUESTION:

"Is a Design Engineer Morally Responsible for His Products?"

M. S. CURTIS
VP Engineering
The Warner & Swasey Co

"The design engineer is ethically bound . . .

to design a product which, in his best judgment, will fulfill the requirements as to function, safety, cost, etc. However, the degree of his moral responsibility for the product should be directly proportional to his authority and control over the design of the product.

"He should not be held responsible for design alterations after the product passes out of his control, nor should he be held responsible for any misuse of the product. For example: in the design of a shotgun, the designer is morally responsible to design it so that it will not explode under ordinary use; but he should not be responsible if the barrel blows up if the user fires it with the muzzle blocked with mud, nor should he be morally responsible if the owner of the gun uses it to shoot his neighbor instead of ducks."

J. H. GERTEIS
Chief Engineer
Commercial Aircraft Div
Cessna Aircraft Co

"He most certainly is! . . .

He must be an exacting individual who may not assume that others will catch his mistakes. In aircraft design, an attitude of complacency is intolerable where strength and safety are concerned. In addition, it is his job to create and develop products which deliver maximum performance, safety and service within the parameters defined by the company for which he works. Since the success of his company depends on how well its products meet and exceed competition, the design engineer must realize that these products originate with him and his efforts will have a direct influence on the company's financial success. Only when he can accept the moral responsibility for his company's products, can he expect to fulfill tbe requirements of his profession."

"Each man is morally responsible . . .

for the work he does. But, I believe it is the further responsibility of each one of us working in the defense industry to take an active interest in civic and governmental matters so that we may retain a voice in determining the ultimate uses of our products.

"The American economy is largely based on our being able to devote a large part of our national wealth to devices whose end-product is destruction. There appears to be no other obvious way to spend so much money and keep so many people employed with the complete approval of the public. Moreover, as an engineer, I would find it difficult to find nondefense work that would be as fascinating or as lucrative as that provided in the defense industry. For myself, I have found the generalized justifications sufficient to assuage my conscience. However, I have witnessed or heard of several cases of mental breakdowns which occurred to people who could not cope with the morality of their situations with equanimity. Lately, I have known an associate, a well-known scientist, who at first would work only in the field of defensive weapons and who finally has entered the clergy. Thus, it becomes a matter for each individual in the defense industry to consider his own case and make peace with his own conscience."

DR R. F. BRODSKY
Head, Staff Engineering
Aerojet Systems Div
General Tire & Rubber Co

H. C. MacDONALD
Chief Engineer
Mercury, Lincoln, Edsel Div
Ford Motor Co

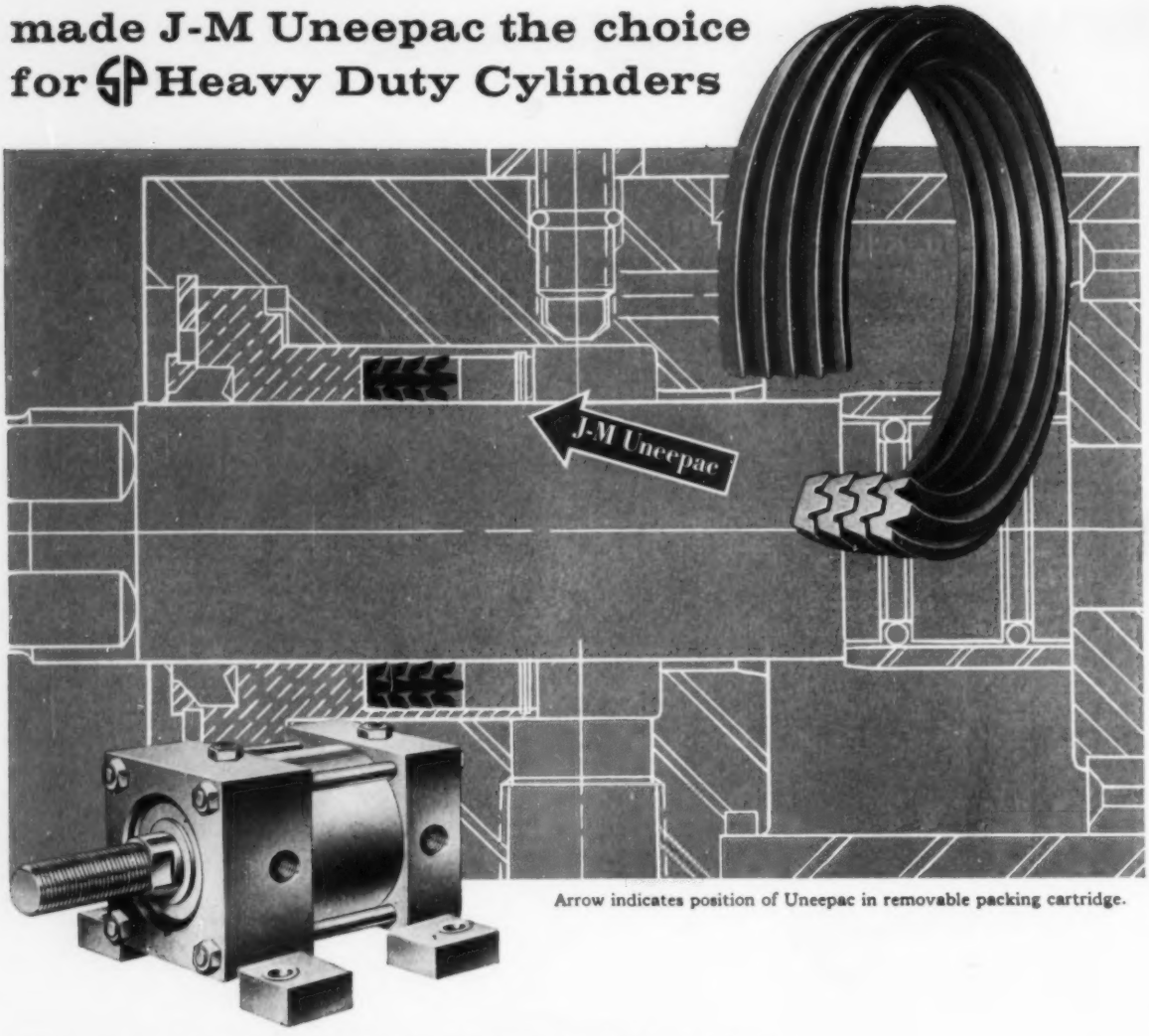
"Most assuredly . . .

a design engineer is morally responsible for his products. An engineer, like other professional people, is the product of many years of education and training—years in which his sense of responsibility to society is sharpened and intensified. This feeling of moral responsibility cannot be engendered by any other means. It must stem from within the engineer himself.

"Here at the Ford Motor Co, we have a little book, called *Canons of Ethics for Engineers*. This book outlines the kind of conduct that is expected of every engineer as a matter of course. I think that the following excerpts reveal most clearly how we feel about the engineer's responsibility to society as well as to his profession: 'The engineer will endeavor to extend public knowledge of engineering, and will discourage the spreading of untrue, unfair, and exaggerated statements regarding engineering. He will have due regard for the safety of life and health of the public and employes who may be affected by the work for which he is responsible. He will guard against conditions that are dangerous or threatening to life, limb, or property on work for which he is responsible, or, if he is not responsible, will promptly call such conditions to the attention of those who are responsible.'"

Compactness . . .

made J-M Uneepac the choice for S-P Heavy Duty Cylinders



Arrow indicates position of Uneepac in removable packing cartridge.

Automatic ring packing helps solve design problem for the S-P Manufacturing Corporation of Solon, Ohio

THE INCREASING TREND toward automation in industrial processes has been made possible by the development of dependable service-free equipment like S-P Heavy Duty Cylinders. Among the design features which make S-P Cylinders so reliable are two Johns-Manville precision moulded packings.

J-M UNEEPAC® automatic ring packing provides maximum sealing in minimum space because each ring is a complete packing unit. This permits an overall reduction of the cylinder size and, in particular, enables S-P to include a quick-change removable packing cartridge. Uneepac is also self-adjusting—each ring positions itself automatically on adjoining rings. Friction is low because when assembled in sets, fluid pressure acts upon each lip individually. Lip section is also well supported to prevent distortion under pressure.

J-M U-CUPS are also used in the S-P Cylinder as piston head packing. They are precision-made for easy assembly, accurate fit, efficient sealing, reduced friction and long life.

Uneepac and U-Cups are made in a variety of compositions for a wide range of hydraulic and pneumatic applications. For further information, write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

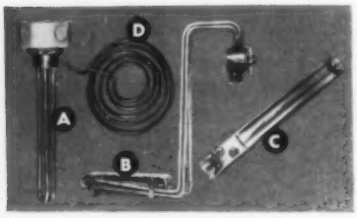
JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

How to choose electric heaters for liquid heating applications

Here is condensed information to help you get the most economical electric heaters for your liquid heating design problem.

Three factors generally determine which type heater should be used for any particular liquid-heating application. They are: the physical characteristics of the container, the nature of the liquid, and the temperature requirements.



General Electric "screw-in" immersion heaters (a) have threaded headers, which make for easy and permanent installation in pipes, tanks and vessels. "Over-the-side" immersion heaters (b) hang in tanks or containers, and besides being portable, they are ideally suited for heating rubber-lined tanks, lead-lined tanks, tanks of wood, slate, and other materials which are not adaptable to heaters with threaded headers.

Because some metals are subject to attack when immersed in certain liquids, G-E heaters are made in a variety of sheath materials so that they can be used for a wide range of liquids. Sheath materials of copper, steel, stainless steel, nickel, nickel-plated copper, nickel-silver, Inconel, Monel, cast iron and lead are all available.

General Electric heaters are ideally suited for heating a wide range of liquids: water, oil, electroplating baths, cleaning compounds, chemical baths, and other fluids. These liquids can be circulating or non-circulating; in open containers, closed or pressure; vessels; kettles, or steam generators. Heavy viscous liquids, such as pitch, molasses, and asphalt can be heated by using a liquid jacket containing immersion heaters.

Where extremely corrosive liquids are to be heated, it is also often best to use a water jacket around the tank. Immersion heaters may be used for water heating in this type of application. Many times, it is easier to clamp strip heaters (c) or tubular heaters (d) to the side of the tank.

TABLE I—Water, Alkaline or Plating Baths

Amount of Liquid		Degrees F Temperature Rise						
Cubic Feet	Gallons	20	40	60	80	100	120	140
		Kilowatts to Heat in One Hour						
.66	5	0.3	0.5	0.8	1.2	1.6	2	2.7
1.3	10	0.5	1.1	1.6	2.4	3.2	4	5.3
2.0	13	0.8	1.6	2.4	3.6	4.5	5.7	7.2
2.7	20	1.1	2.2	3.2	4.8	6	7.5	9.5
3.3	25	1.3	2.7	4	6	7.5	9.5	12
4.0	30	1.6	3.2	4.8	7	8.8	11	14
4.7	35	1.9	3.7	5.6	8	10	13	16
5.3	40	2	4	6	9	12	15	20
6.0	45	2.4	5	7	11	14	18	23
6.7	50	2.7	5.4	8	12	15	19	24
7.4	55	3	6	9	13	16	20	25
8.0	60	3.3	6.4	9.6	14.5	18	23	29
8.7	65	3.5	7	10	15.5	19.5	25	31
9.4	70	3.7	7.5	11	17	21	26	33
10	75	4	8	12	18	23	29	37
10.7	80	4.3	8.5	13	19	24	30	38
11.4	85	4.5	9	13.5	20	25	31	39
12.0	90	5	10	14.5	22	28	35	44
12.7	95	5	10	15	23	29	37	47
13.4	100	5.5	11	16	24	30	38	48
16.7	125	7	13	20	30	38	48	60
20.0	150	8	16	24	36	45	57	72
23.4	175	9	18	28	42	53	67	85
26.7	200	11	21	32	48	60	75	95
33.7	250	13	27	40	60	75	95	120
40	300	16	32	47	70	88	110	140
46.8	350	19	37	56	83	105	130	165
53.4	400	21	43	64	96	120	150	190
60.1	450	24	48	72	107	135	170	214
66.8	500	27	53	80	120	150	190	240
Maximum Time (hours)		10	10	7	5½	5	4	3½

TABLE II—Use This Table for Oil

Amount of Oil To Be Heated		Degrees F Temperature Rise					
Cubic Feet	Gallons	50	100	200	300	400	500
		Kilowatts to Heat in One Hour					
.5	3.7	.3	.5	1	2	2	3
1	7.4	.5	1	2	3	4	6
2	14.9	1	2	4	6	8	11
3	22.2	2	3	6	9	12	16
4	29.9	2	4	8	12	16	22
5	37.4	2	4	9	15	20	26
10	74.8	5	9	18	29	40	52
15	112.5	7	14	28	44	60	77
20	149.6	9	18	37	58	80	102
25	187.	11	22	46	72	100	127
30	222.5	13	27	56	86	120	151
35	262.	16	31	65	100	139	176
40	299.	18	36	74	115	158	201
45	336.5	20	40	84	129	178	226
50	374.	22	45	93	144	197	252
55	412.	25	49	102	158	217	276
60	449.	27	54	112	172	236	302
65	486.	29	58	121	186	255	326
70	524.	32	62	130	200	275	350
75	562.	34	67	140	215	294	375
Maximum Time (hours)		10	10	8	7	6	5

To figure the amount of heat required for your application:

1. Find the number of gallons or cubic feet of liquid to be heated.

2. Figure needed temperature rise in degrees F. (Subtract initial temperature from needed temperature.)

3. Check either Table I or Table II from the nearest amount of liquid to the desired "temperature rise" in the right-hand column.

4. Add 4% to the figure you now have if there is no insulation on your container or tank.

5. Divide the answer in Step 4 by the number of hours available for initial heat-up of the liquid. You now know how many kilowatts of heat are required for your installation.

For complete information on sizes and ratings of General Electric heaters, call your General Electric Apparatus Sales Office or send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

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PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

Section G723-26, General Electric Co., Schenectady 5, New York

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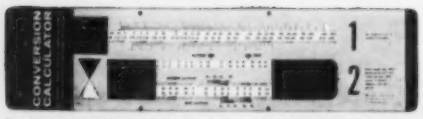

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With the exclusive new Alcoa Conversion Calculator, it's a snap to find total costs and resulting per cent savings in switching to aluminum screw machine stock . . . in just three minutes or less. This handy slide-rule calculator does all the mathematical computations! Just set the part length at the stock size and read out the pounds of brass and aluminum per 1,000 pieces . . . with *automatic allowance* for 5 per cent operating scrap, 3 per cent bar end loss and 0.103-in. cutoff and facing loss. Then, determine your local material costs and—zip!—you've got the gross rod or bar costs for both metals. The reverse side of the calculator gives you an equally fast answer for the percentage savings when you switch to Alcoa® Aluminum.

Call your Alcoa sales office or Alcoa distributor today for an Alcoa Conversion Calculator. You'll find them listed in the Yellow Pages of your telephone directory under "Aluminum."

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Alcoa Aluminum Screw Machine Stock Alloys:

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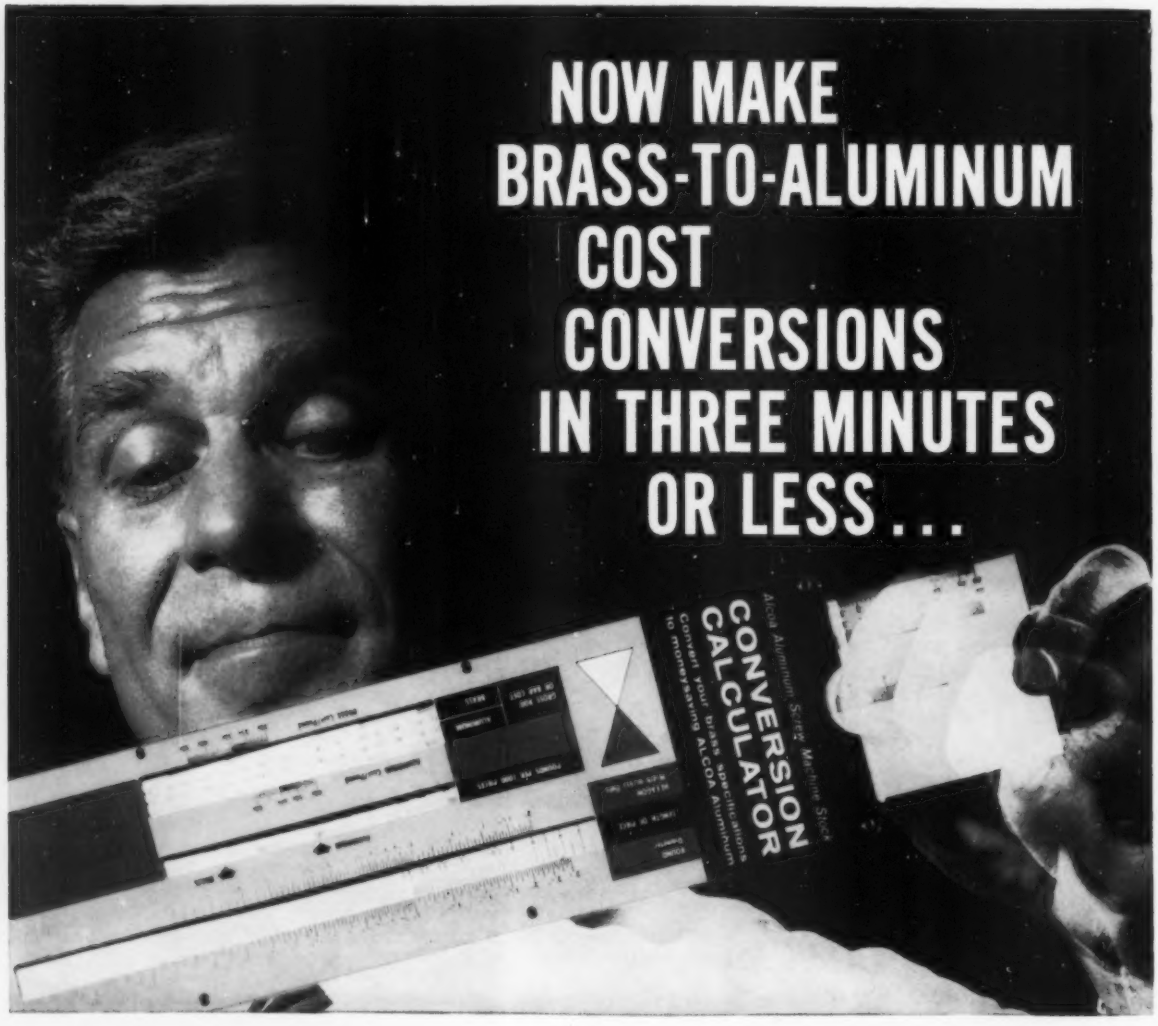
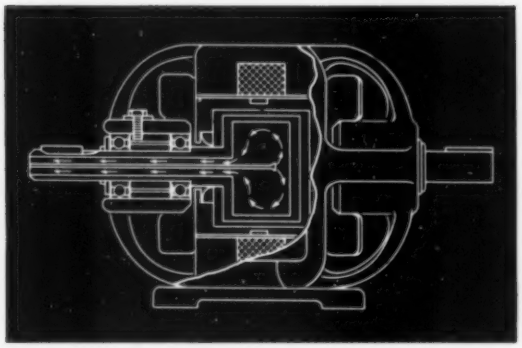


SIGNIFICANT COMPONENTS MATERIALS PROCESSES

Steel coils are precoated . . .

with continuous film of non-oriented polyester. Previously available only in cut sheets; also clear plastic film was underprinted with desired pattern, then backed with colored base coat, forming a sandwich with printing as core. This was then adhesive-bonded to sheet metal. Thickness of base coat was critical, as it affected color tone. In new process, unbacked and printed clear plastic is used and pigment is added to thermosetting or thermoplastic adhesive that bonds plastic to steel. Plastic top film is between 0.001 and 0.003 in. thick, depending on user requirements. Steel between 0.008,2 and 0.050 in. thick has been coated in this manner and is said to permit the same forming operations as uncoated steel. At present, joining is by mechanical means, such as fasteners and crimping. Only minor variations are needed to process any organic film to any metal coil. Up to 32 in. wide available from stock; 48 in. wide material available by end of year. Priced between vinyl-to-steel laminates and plastisol coated steel. **Enamelstrip Corp, Div of National Steel Corp, Hamilton and 20th Sts, Allentown, Penna.**

Circle 101 on Reader Service Card



Water-cooled clutch . . .

is for applications requiring a high degree of slippage, such as tension control and cycling. Magnetic particle clutch can also be used for braking. Flow of water within inner rotating member dissipates heat generated by continued slipping without sacrificing torque capacity. Available in either bored or hollow rotor (shown) styles in 8 models from 10 to 200 lb-ft rated torque. Heat dissipation capacity is said to be up to six times that of standard air-cooled magnetic clutches. List prices range from $310 to $1127; rotary joints are $60 and $100 additional. Delivery, 4 to 8 wk at present; from stock by mid-November. **Vickers Inc, Electric Products Div, 1815 Locust St, St Louis 3.**

Circle 102 on Reader Service Card

Endless counter tape . . .

was originally developed for display of two left-hand digits in 360° bearing counter, which was reduced in weight and cut to about half normal size of such counters as a result. Numerals on present tape are ¼ in. high. Panel opening requires 13/16 x 9/32 in. Tape is perforated to fit sprocket teeth on instrument drum and may be led through various configuration or paths to fit within an instrument and avoid internal components or other obstructions. May be operated at 400 rpm constant speed or up to 750 rpm intermittently. **Veeder-Root Inc, Hartford 2, Conn.**

Circle 103 on Reader Service Card

High-strength silicone rubber . . .

is said to be unaffected by time, weather, sunlight or ozone. Remains flexible at −105 F; resists heat to 500 F. Electrical insulation qualities are reported to be good. Tensile strength of silicone rubber compound is over 2,000 psi and tear strength is above 300 lb per in. Possesses good aging qualities, i.e., 1,700 psi and 250 lb per in. tear resistance after 24 hr at 480 F. Can be specified for extrusions, moldings, extruded and spliced parts or in combination with metals, reinforcing fabrics or with Teflon bonded to the surface. Available in finished parts for immediate delivery. Prices are said to be comparable to silicone rubber products now on the market. **Connecticut Hard Rubber Co, New Haven, Conn.**

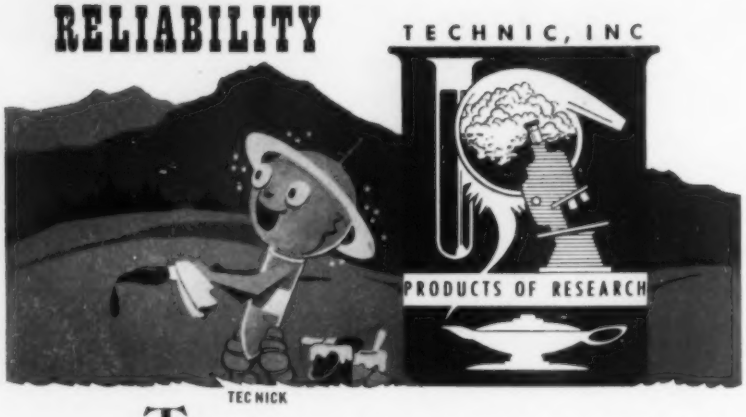
Circle 104 on Reader Service Card

Forming characteristics . . .

of a new grade of straight chromium stainless steel strip are said to be improved by small alloy addition and application of new processing techniques. Said to represent improvement over Type 430 stainless when used in stretch bending and deep drawing, though surface characteristics and corrosion resistance are equal. Base price is 42½¢ per lb. Now being produced in strip form. **Universal-Cyclops Steel Corp, Bridgeville, Penna.**

Circle 105 on Reader Service Card

SIGN OF RELIABILITY



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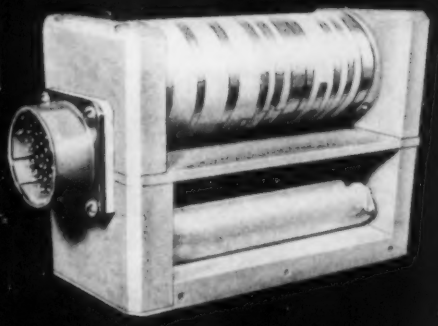

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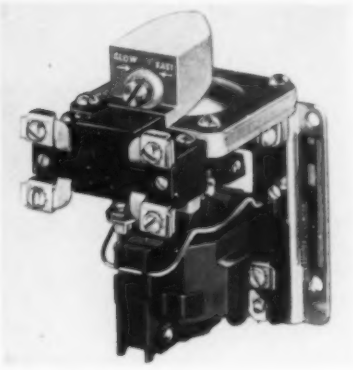

Pneumatic timer . . .

has internally ported air system that makes it applicable for use in dusty or dirty atmospheres. Timing range is adjustable from 0.2 sec to 1 min. Available for ac and dc operation. $38, list. Stock delivery. **Square D Co, 4041 N Richards St, Milwaukee 12.**

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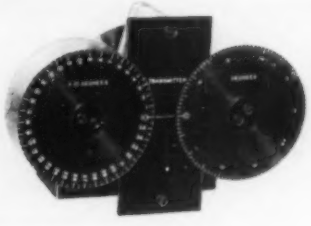

Geared dial assembly . . .

suited for use as two-speed indicating device or as speed reducer, possesses over-all transmission accuracy characteristics of better than 9 min. Twin dials can be read to accuracy of 15 min. or less. Stock units are available with over-all gear ratios of 10:1, 18:1, 24:1, or 36:1. Blank dials supplied with unit are 3/32 in. engraving stock, 3 in. dia with ⅜ in. bore. Standard assemblies have coarse dial marked in 10° intervals and vernier dial calibrated to tenths of a degree. Gears used are AGMA Class II, 20° pressure angle, 48 or 64 pitch. Max backlash is less than 0.002,5 in. per mesh. Stock units are about $140 each. **Components-Marketing Div, Reeves Instrument Corp, Roosevelt Field, Garden City, NY.**

Circle 107 on Reader Service Card

Precision hysteresis motor . . .

is said to be insensitive to line or power supply voltage variations. Utilizes axial

air gap design. Motor-induced flutter is reported not to exceed 0.1 rms at 1,200 rpm or 0.15 at 360 rpm while stray external magnetic field with normally shielded head is held to −47 dbm. Withstands ambient temperatures from -25.6 to 275 F. For tape drive, an integrally ground capstan is available with concentricity maintained to TIR 0.000,2 in., with less than 50-millionths grind lobe pattern. **Hysyn Electromotive, Dept SMA 557, 915 N Citrus Ave, Los Angeles 38.**

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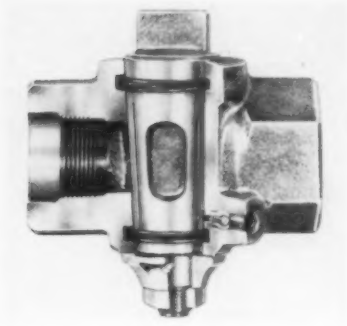

Ductile iron stop valves . . .

for gas are now available in lock-wing models in ¾ and 1 in. sizes, in addition to solid flat head types. Double-surface seals prevent leakage and pressurize built-in lubrication system. Pressure forces grease in reservoir into four vertical greasing grooves in key. Each time stop valve is operated, grooves distribute predetermined amount of grease on scaling surfaces. Grease grooves are connected with body lubricant reservoirs only in fully-opened and fully-closed positions, preventing high pressure from forcing grease out of grooves while valve is being operated. Relubricating port permits relubrication under full line pressures to 500 psi. Ball-check valve prevents high pressure from blowing grease out of stop when filling reservoirs. **Mueller Co, 512 W Cerro Gordo, Decatur, Ill.**

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Adjustable time delay . . .

relay incorporates miniature potentiometer. Delay times are set by external screwdriver adjustment. Available in 50 millisec to 2 sec and 2 to 50 sec standard time ranges. May be delayed pull-in or delayed drop-out. 5-½ oz units recycle instantly, even if de-energized before timing cycle is completed. Withstands 50 g shock for 11 millisec; vibration of 20 g to 2,000 cps; ambient temperatures of −67 to 159.8 F. Accuracy is said to be 10% of nominal, for any combination of ambient temperature and/or input voltage. **Master Specialties Co, 956 E 108th St, Los Angeles 59.**

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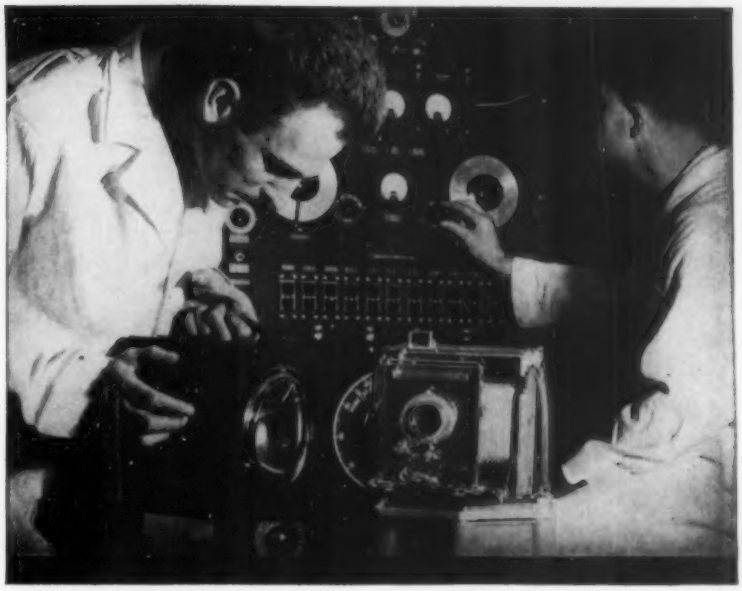

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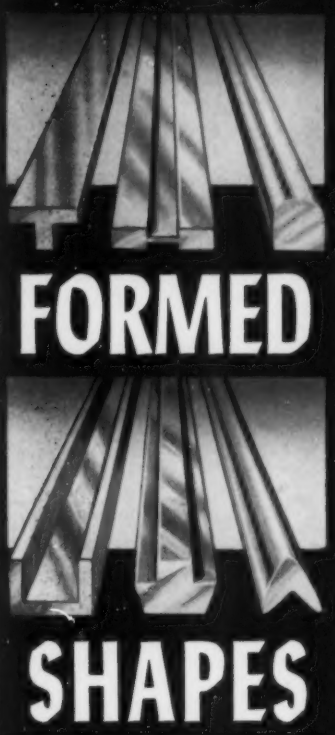

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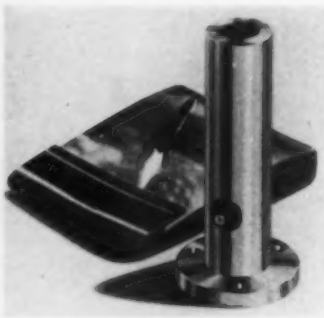

Timed-action switch . . . responds to acceleration forces from 1 to 40 g within a tolerance of 5% of setting. Time delays can be adjusted between 0.5 and 1.5 sec. When axial acceleration force exceeds pull of magnet, precision ground steel ball, held in place by two-pole magnetic field, is released and moves to close normally open electrical contact. Meets environmental specs of MIL-E-5272, including operating range of −65 to 200 F. Inertia Switch Inc, 311 W 43rd St, New York 36.

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¾w zener diodes . . . in axial-lead, flangeless packages are available in ratings from 6.8 to 200 v. Said to be useful in ac and dc circuits and to be suitable for miniature equipment because of small size and weight. Motorola Semiconductor Div, Dept ZD, 5005 E McDowell Rd, Phoenix, Ariz.

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ments. Line also features tubes that are variable in length and for either gas or fluid immersion applications. Outputs range from 0 to 5 v; senses temperatures from −320 to 1,000 F. Sensing elements are available in nickel-iron, platinum and thermistor materials. Fluid immersion units are for 4,500 psi to 1,000 F; gas immersion units for 4,500 psi at 77 F and 2,000 psi at 1,200 F. **Arnoux Corp, 11924 W Washington Blvd, Los Angeles 66.**

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with micrometer adjustment to set pitch to desired rpm on driven pulley is available in ½ to ⅝ in. bore sizes. 3-¼ in. dia pulley can be used with ⅜, ½ and ⅝ in. top width V-belts. Each half of pulley is fastened directly to motor shaft, which eliminates parallel or angular misalignment between halves. Concentricity between groove and bore is said to be 0.010 in. total indicator reading, max. Max side wobble of groove is said to be 0.005 in. total indicator reading. **Congress Drives Div, Tann Corp, 3750 E Outer Dr, Detroit 34.**

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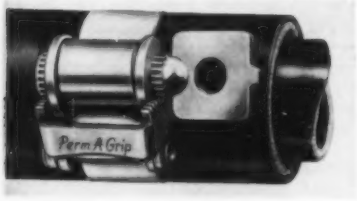

Adjustable hose clamp . . .

fits diameters from ½ to 2¾ in. and reels in unused portion of band, leaving no excess exposed to cause snagging. Pawl-and-ratchet locking arrangement is set with thumb and index finger and tightened with small pliers or nail. Stainless steel band and plated buckle are said to meet required specifications. Available in larger sizes, too. Also offered as kit, with clamps to be assembled to accommodate any diameter. **Perm-A Mfg Co, 296-98 N Spring Garden St, Ambler, Penna.**

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Eastman 910 Adhesive is making possible faster, more economical assembly-line operations and new design approaches for many products. It is ideal where extreme speed of setting is important, or where design requirements involve joining small surfaces, complex mechanical fasteners or heat-sensitive elements.

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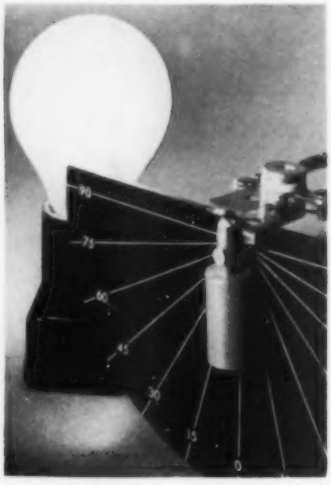

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for portable electrical appliances that are electrical or fire hazards when tipped operates when switch is tipped more than 45° from vertical. Actuator is pivoted, steel pendant that tends to maintain vertical position at all times, regardless of switch position. Switch uses stainless steel contact springs with spot-welded silver contacts. Available with spade or screw terminals. Rated at 15 amp, 118 v or 8 amp, 236 V. **Bryant Electric Co, Bridgeport 2, Conn.**

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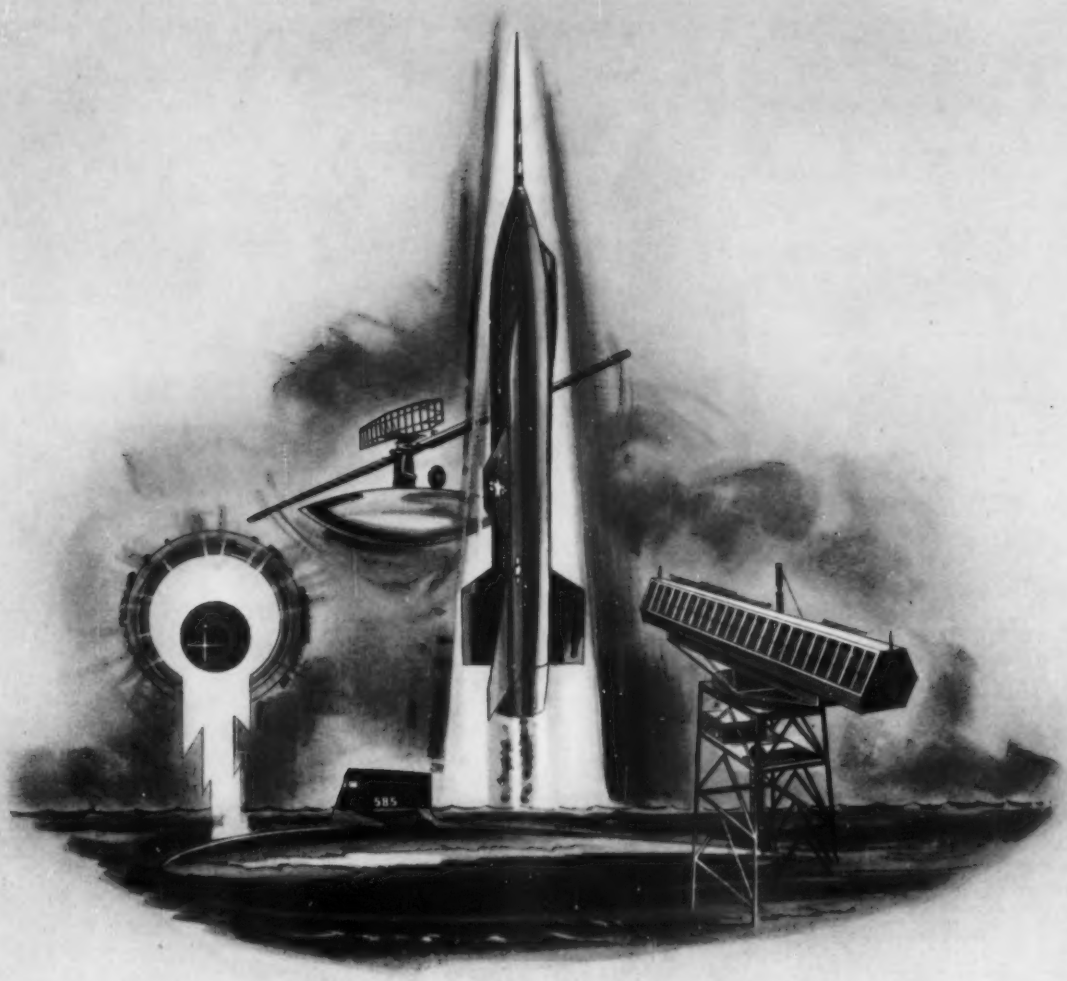

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For a layman, one of the most frightening aspects of science is its vocabulary. Dr. Isaac Asimov has written a book for laymen tracing the origins of words in an attempt to provide a semantic understanding of the scientists' language. The book is far too brief to be used as a dictionary and far too limited to act as an encyclopedia. However, if you didn't know that "petroleum" is latin for "olive oil from a rock," or "lens" is named for the lentil bean it resembles or that a straight line comes from the words "stretched linen", then Words of Science will bring you some interesting background.

Since the book is laid out with each word dissection on a single page in alphabetical order, there is no continuity between pages; the jump from Granite to Gravity or from Cyclone to Cyclotron is too abrupt. It makes what could be interesting reading too much like curling up with a dictionary.

—BAL

Individual Creativity and the Corporation

Authored by students of Manufacturing Group 25, Harvard Graduate School of Business Administration. Published by Institute of Contemporary Art, 230 The Fenway, Boston 15. Paperbound, 8½ x 11, 310 pp. $16.50.

What are businessmen doing about helping individuals to be more creative? Here is a report compiled by seven graduate students at Harvard Business School after a year of intensive study and interviews with businessmen, inventors, psychologists, and research and development executives. For the most part, it is a compendium of prevailing opinions and ideas; however, in chapter eight, the authors offer two proposals of their own—aids to creativity in the organization.

The book is divided broadly into three parts: statement of the problem—what is creativity and what barriers to it exist; methods of improving creativity—brainstorming and other group techniques as well as individual methods; problems of integrating these methods into corporate activity. In addition, there are final chapters summarizing American achievements as an inventive or creative nation from both the basic research and the educational standpoint.

John Arnold, Professor of Mechanical Engineering, Stanford University, praises it as "One of the best books on this subject that has appeared in recent years." And William J J Gordon, Head, Operational Creativity Group, Arthur D Little Inc, says, "This is one of the best and most coherent reports on creativity I have read to date—excellent."

—CJL

DATA REDUCTION AND DIGITAL CONTROL—Handbook, 76 pp. Covers theory behind shaft position encoder; systems; input, processing and output components; accessories and case histories of representative systems now in use. Coleman Electronics Inc, 133 E. 162nd St, Gardena, Calif.

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COMPONENT MANUFACTURE—Brochure, 10 pp. Outlines facilities in design, for pilot models, engineering and production of transformers, coils, wire harnesses and cable assemblies. Also handles contract assembly work. Skysweeper Inc, McHenry, Ill.

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TESTING FACILITIES—Brochure AB-1, 8 pp. Profusely illustrated booklet shows views of lab equipment, testing procedures, processes and report form. Specializes in testing electrical, electromechanical and electronic components. Astrolab Testing Corp, 11615 McBean Dr, El Monte, Calif.

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Manufacturers who published following literature ask that requests for copies be made on company letterheads.

THE LATTICE—Vol 1, No. 1. First issue of semiconductor technical journal. Complimentary subscriptions may be obtained by request on company letterhead. Dept A, Tung-Sol Electric Inc, 1 Summer Ave, Newark 4, NJ.

ELECTRONIC TRAINING AID—Catalog sheet 901-B, 2 pp. Describes circuit board that may be used in classroom to allow students to build and rebuild circuits. Plastic Associates, 185 Mountain Rd, Laguna Beach, Calif.

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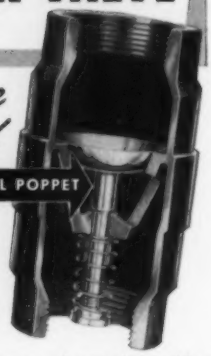

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Easier Money?

Now it's the pound—the pound sterling, that is—that's being challenged. Close on the heels of suggestions that we convert linear measurements to the metric system and that a standard gallon be established (*PE*—May 18, p 9) comes British Commonwealth action to exchange pounds and shillings for a decimal currency.

India is making the change now. The Union of South Africa has voted to do so next year. The British West Indies are converting too, and have agreed that when a single currency is adapted it will be a dollar system. Now Australia has appointed a parliamentary committee to investigate the idea.

Will Britain itself follow suit? There's a powerful lot of sentiment behind the pound—and a lot of pounds involved in a changeover. It's a costly and complex business.

The big stumbling block is not the pound itself but the awkward penny—12 to a shilling and 240 to a pound. One suggestion: devalue the penny so there would be 10 to a shilling, and set up a mill valued at ¼ penny. Then, there would be 1000 mills or 200 pence to a pound. That way, at least, the familiar words would remain. It's not likely to happen right away; but pressure from the Commonwealth nations and within Britain itself could bring a changeover in the not-too-far-distant future.

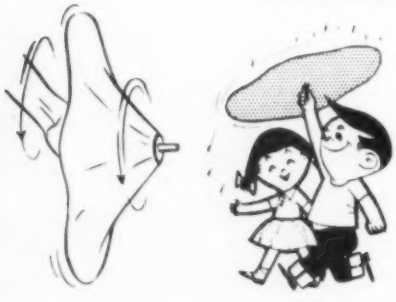
What it takes to be airborne

It's not just increasing size and power that makes airplanes so expensive (*PE*—Oct 5, p 4); it's the little things as well, says Northwest Orient Airlines. Here's a brief rundown of its shopping list for the new Electras:

Carburetor: $700	Windshield: $975
Heater: $1800	Wheels: $507 each
Sparkplugs: $24.50 each	Oil filter: $802
Oil pumps: $395 each	Ash trays: $9.75 each

And the engines? They're practically cheap: only $115,000 apiece.

Pie in the sky



An aeronautical engineer with a bolt of cloth, a weight, and a grommet, is responsible for the device pictured here—successor to the hula hoop, its manufacturer hopes.

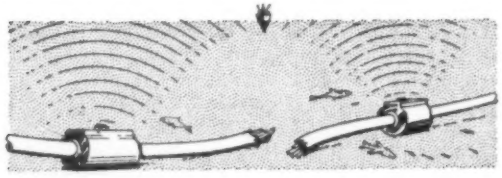
Says Kusan Inc, Nashville, Tenn: "The precision engineering in the cut of the cloth and placement of the weight makes it possible—with a bit of skill—to change speed and position, walk, or even run while keeping the cloth platter going." It's furnished (for 98¢) with a stick to spin it on; but, the manufacturer notes, you can use your index finger. The name—what else?—Pizza Pie.

—ARG

Why Don't They RESEARCH and DEVELOP . . .

. . . a camera that prints exposure data on the margin of the film. A small portion of the light passing through the lens could be reflected through a stencil coupled to the f-stop and shutter-speed controls. When the shutter snaps, the information would be exposed on the edge of the film. Or in place of the stencil, metal type could be used to stamp the data on the edge of the film as in novelty cameras (common about 20 years ago) in which notes, messages, data could be written on the emulsion with a metal stylus as each picture was taken. The stamping action could be tripped and reset as the film was wound. —L GOLDEN

. . . a simple, inexpensive way to create a magnetic field on the surface of a drafting board or a loft floor. This would work like a magnetic chuck to hold flexible splines (made of a ferrous material) for drawing long, irregular curves. It would eliminate the need for spline weights or ducks. —J W SULLY



. . . a method of locating breaks in underwater cables. Each repeater station could be equipped with an oscillator and transducer that would transmit sound waves through the water. When a break occurred, sonic generators in the two repeater stations adjacent to the break would be set off. Shipboard detectors could spot the break quickly and repair the cable in the usual way. —R PRESTON

. . . a rechargeable oil filter for automobiles. When the oil is drained, the trapped dirt and sludge is flushed into the sump and drained with the oil. Releasing trapped dirt could be done by turning a valve, which momentarily reverses flow through the specially designed filter. Or if particles were held electrostatically, reversing the charge would release them. —R A NEILSON

Have you a problem, based on known scientific principles, which seems to have an answer somewhere within the limits of present technology? To inspire inventors along worthwhile paths, PROJECT ENGINEERING invites you to trade such problems with fellow readers who may have a fresh viewpoint or more time for necessary R & D. We will pay $10 for each one accepted.

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Publisher's Postscript...

MEDICINE for the DOCTOR

You will recall our 6-article series early this year on how to read. The series was not hard-core engineering material, the traditional content of *Product Engineering*, but a hard-headed effort to help you solve a problem that is at least as pressing as any technical one.

The response was amazing. We've distributed more than 7000 reprints, about twice the best for any technical article we've offered, and some thousands of engineers also bought the book on the subject from Reading Laboratory.

We were particularly impressed, however, by several letters from readers about the series. One, from Anthony P. Vogelpoel of Lily Cups in Toronto, admitted that he was about to cancel his subscription because he had too much to read and too little time, but said he'd changed his mind because of the value of the reading series. Then he went on to suggest we do another series on how to write engineering reports.

Here was medicine for the doctor! We took it, as you know. Dick Koff, senior associate editor, was elected to produce the current 8-article series. We were a bit apprehensive—telling a friend how to write is almost as dangerous as telling one how to win friends—but we began publishing.

The results are again amazing. We had half a dozen requests for permission to reprint in other magazines and house organs before half the series had appeared. Comments like: "Excellent . . ." "Our people will certainly benefit . . ." ". . . hand you a handsome bouquet. Every engineer of whatever training or experience should read and re-read these articles. They are simple, practical and useful. . . ." One budding engineer—a lady, incidentally—caught us in a grammatical error in the same issue as the first article and suggested we take our own advice. An old-timer in public relations postscripted: "Incidentally, I think *Product Engineering* is one of the most skillfully edited publications I see."

There's more. We've already had more than 2500 advance requests for reprints of the series when it is completed, and the rate is accelerating. If you haven't sent in your request yet, and want this 12-page reprint, just circle number P15 on the postcard on this page, sign and send the card.

We've gotten more medicine like Mr Vogelpoel's that we're planning to take. Sometimes, like castor oil, it's a little bitter, but often, like rock-and-rye, it's a real pleasure to swallow. You'll see the results of these dosages as time goes by. And if you have some medicine for us, some way in which you think we can improve *Product Engineering's* service to you, send it along. We'll appreciate it. —SJA

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